

Foreign direct investment by small and medium-
sized enterprises:

The case of German nanotech and biotech SMEs

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Abstract

Equity entry modes are increasingly important regarding the internationalisation agenda of high-tech SMEs (HTSMEs). However, the fields of international business, international entrepreneurship and strategic management have not been able to provide or identify a specific theory or framework, which is able to explain the relevant factors related to the asset-exploiting and asset-augmenting FDI of HTSMEs. Therefore, in light of the absence of a specified analytical approach to the FDI of HTSMEs, the aim of this study was to test whether the new envelope paradigm framework, which additionally accounts for dynamic knowledge related factors and strategic asset seeking FDI, can serve as an analytical tool to explain the different types of FDI of HTSMEs.

This study employed a cross sectional research design and conducted an email survey. The survey was based on an authoritative federal database, which was extended by the researcher into a state of the art tailor made census database of German nanotech and biotech SMEs. The firm- and location-specific variables in the conceptual framework were adopted and adapted from related studies. The results indicate that the envelope paradigm framework is able to explain the asset-augmenting FDI of HTSMEs. The relevant knowledge related firm-specific advantages (O-advantages) are the absorptive capacity and the internal knowledge network of the HTSME. Important knowledge related location advantages (L-advantages) are highly skilled workforce, innovative public and private scientific institutions and industrial concentrations. In terms of the asset-exploiting FDI of HTSMEs, the framework was able to determine relevant O-advantages such as scale economies and the internal support structure of the HTSME. However, the framework was not able to identify important L-advantages for the asset-exploiting FDI of HTSMEs.

Overall, the findings imply that the envelope paradigm framework can serve as an analytical tool for understanding a substantial amount of the asset-exploiting and asset-augmenting FDI of HTSMEs. It provides a comprehensive picture of the structure and composition of HTSMEs that engage in the different types of FDI. The results contribute to the interdisciplinary debate on the compatibility and suitability of an IB framework in an entrepreneurial context. Furthermore, this study can assist HTSME managers in effectively configuring FDI strategies according to firm-specific abilities and location specific attributes. Policy makers could use this study in designing policies and support schemes to the specific requirements of this new type of HTSME.

In a wider context, the findings bare relevant implications beyond the context of nanotech and biotech industries and the country context of Germany. It provides valuable insights for the group of coordinated market economies such as Germany and for other high high-tech industries, which increasingly define the future of mature industrialised economies.

Declaration

This thesis is submitted in fulfilment of the requirements of the Manchester Metropolitan University for the degree Doctor of Philosophy. No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institution of learning.

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Table of contents

Abstract	i
Declaration	ii
Acknowledgements	iii
Table of contents	iv
List of tables.....	ix
List of figures	x
List of abbreviations	xi
1 Introduction	1
1.1 Background of the research.....	1
1.2 HTSMEs and FDI	6
1.3 Statement of the gap.....	9
1.4 Contribution to knowledge.....	16
1.5 Research aim and objectives	19
1.6 Research questions.....	20
1.7 Definition of key terms	20
1.8 Structure of the dissertation	22
2 Research context.....	24
2.1 SMEs.....	24
2.2 High-tech and high-tech industries	26
2.3 HTSMEs	29
2.4 HTSME internationalisation	31
2.5 Background of Germany	32
3 Literature review.....	35
3.1 Structure of the literature review	35
3.2 Schools of thought	35
3.3 International entrepreneurship	38
3.3.1 Introduction.....	38
3.3.2 Strength and weaknesses of IE concepts in HTSME internationalisation research	39
3.4 The international business school	43
3.4.1 Introduction.....	43
3.4.2 Approaches to internationalisation in SME research	44
3.4.3 Relevant theories and frameworks in HTSME internationalisation research	47
3.4.3.1 Internalisation theory	47
3.4.3.2 Stage approaches.....	51

3.4.3.3 Network theory	54
3.4.3.4 Resource-based view.....	58
3.4.3.5 Knowledge-based view	60
3.4.3.6 Dynamic capabilities perspective.....	64
3.4.4 Summary of the reviewed theories and frameworks	66
3.4.5 Eclectic envelope paradigm	68
3.4.5.1 Introduction.....	68
3.4.5.2 The FDI motivations in the eclectic envelope paradigm.....	70
3.4.5.3 The asset-exploiting FDI perspective in the envelope paradigm	72
3.4.5.4 The asset-augmenting FDI perspective in the envelope paradigm.....	73
3.4.5.5 The eclectic envelope paradigm in the empirical SME and high-tech context	76
3.4.5.6 Summary of the eclectic envelope paradigm	78
3.5 Synthesis of the literature review and justification of the gap	78
4 Conceptual framework: The envelope paradigm in a HTSME context	82
4.1 Foundation of the framework.....	82
4.2 The ownership sub-paradigm.....	83
4.2.1 O-advantages related to asset-exploiting FDI	84
4.2.2 O-advantages related to asset-augmenting FDI	88
4.3 The location sub-paradigm.....	93
4.3.1 L-advantages related to asset-exploiting FDI	94
4.3.2 L-advantages related to asset-augmenting FDI.....	96
4.4 Summary	103
5 Methodology	105
5.1 Introduction.....	105
5.2 Ontology and epistemology	105
5.2.1 The subjectivist and objectivist paradigm.....	107
5.2.2 Scientific realism.....	109
5.3 Research design	110
5.3.1 Explanatory vs exploratory designs	111
5.3.2 Quantitative vs qualitative designs	112
5.3.3 Cross sectional research design.....	114
5.4 Research method and instrument	115
5.4.1 Research method and data collection instrument.....	115
5.4.2 Sampling	118
5.4.2.1 Unit of analysis	118
5.4.2.2 Sampling process	119
5.4.3 Maximising response rate	121

5.4.4 Questionnaire construction and question design.....	123
5.4.4.1 Questionnaire validity	123
5.4.4.2 Measurement items	124
5.4.4.3 Structure and translation of the questionnaire.....	124
5.4.5 Pilot study	126
5.4.6 Data collection process	128
5.5 Operationalisation of key variables.....	129
5.5.1 Dependent variable: Type of FDI	129
5.5.2 Independent variables of interest	130
5.5.2.1 O-advantages related to asset-exploiting FDI	131
5.5.2.2 O-advantages related to asset-augmenting FDI	133
5.5.2.3 L-advantages related to asset-exploiting FDI	136
5.5.2.4 L-advantages related to asset-augmenting FDI.....	137
5.5.2.5 Control variables	141
5.5.2.6 Foreign location variable	143
5.6 Response analysis	144
5.6.1 Response rate	144
5.6.2 Pre-estimation tests: Representativeness and non-response bias	144
5.7 Statistical instrument for hypothesis testing	146
5.8 Summary	148
6 Data analysis and results	149
6.1 Introduction.....	149
6.2 Data transformation and analysis.....	149
6.2.1 Missing values	149
6.2.2 Pre tests	149
6.2.2.1 Sample size	150
6.2.2.2 Normality	150
6.2.2.3 Outliers.....	151
6.2.2.4 Multicollinearity.....	152
6.2.3 Common method bias	153
6.2.4 Post-estimation analysis.....	155
6.3 Descriptive statistics and univariate analysis.....	155
6.3.1 Comparison of firm characteristics between HTSMEs with FDI and non-equity entry	155
6.3.2 Comparison of firm characteristics between asset-exploiting and asset-augmenting HTSMEs	160
6.4 Regression models and results	164
6.4.1 Introduction.....	164

6.4.2 Control variables in the regression analysis.....	164
6.4.3 Logistic regression results.....	165
6.4.3.1 Model diagnostics	165
6.4.3.2 O-exploiting advantages and FDI activities	165
6.4.3.3 O-augmenting advantages and FDI activities	166
6.4.3.4 L-exploiting advantages and FDI activities	167
6.4.3.5 L-augmenting advantages and FDI activities.....	167
6.5 Summary of the chapter	171
7 Discussion.....	173
7.1 Introduction.....	173
7.2 Equity and non-equity entry of HTSMEs in light of firm-specific characteristics	174
7.2.1 The foreign entry modes of HTSMEs.....	174
7.2.2 The extent of asset-exploiting and asset-augmenting FDI of HTSMEs.....	176
7.3 The FDI of HTSMEs in light of O and L-advantages.....	179
7.3.1 O-exploiting advantages and the FDI of HTSMEs	180
7.3.2 O-augmenting advantages and the FDI of HTSMEs	183
7.3.3 L-exploiting advantages and the FDI of HTSMEs	188
7.3.4 L-augmenting advantages and the FDI of HTSMEs.....	190
7.3.5 Summary of the O and L-advantages related to FDI	196
7.4 Suitability of envelope paradigm for analysing the types of FDI of HTSMEs.....	197
8 Conclusion.....	201
8.1 Core contributions to knowledge	201
8.2 Empirical contributions.....	203
8.3 Methodological contribution.....	206
8.4 Implications for public policy	207
8.5 Managerial implications.....	209
8.6 Limitations of the study	211
8.7 Future research.....	213
Appendix.....	216
Appendix A: Contact email and questionnaire	216
Appendix A1: English version.....	216
Appendix A2: German version	220
Appendix B: Descriptive statistics	
Appendix B1: Extensive descriptives	224
Appendix B2: Mean analysis of asset-exploiting and asset-augmenting HTSMEs.....	225
Appendix C: Diagnostics	226
Appendix C1: Transformed variables	226

Appendix C2: Outliers	226
Appendix C3: Influential cases	227
Appendix C5: Multicollinearity	231
Appendix C6: Split sample tests	232
References	234

List of tables

Table 2.1 SME classification	24
Table 3.1 Empirical HTSME studies adopting international entrepreneurship perspective.....	40
Table 3.2 Empirical HTSME studies adopting internalisation theory.....	50
Table 3.3 Empirical HTSME studies adopting stage approaches	54
Table 3.4 Empirical HTSME studies adopting the network perspective	56
Table 3.5 Empirical HTSME studies adopting RBV	59
Table 3.6 Empirical HTSME studies adopting KBV	62
Table 3.7 Empirical HTSME studies adopting the dynamic capabilities perspective.....	65
Table 3.8 Summary of theoretical approaches in HTSME research.....	68
Table 3.9 Empirical SME studies adopting the envelope paradigm.....	77
Table 4.1 Summary of hypotheses.....	103
Table 5.1 Quantitative vs qualitative research	113
Table 5.2 Evaluation of the email survey design	117
Table 5.3 Operationalisation of the dependent variable.....	130
Table 5.4 Operationalisation of the variables related to O-exploiting FDI	133
Table 5.5 Operationalisation of variables related to O-augmenting FDI.....	136
Table 5.6 Operationalisation of variables related to L-exploiting FDI	137
Table 5.7 Operationalisation of variables related to L-augmenting FDI.....	140
Table 5.8 Operationalisation of control variables.....	142
Table 5.9 Response rate.....	144
Table 5.10 Wave analysis.....	145
Table 6.1 Regression results	169
Table 6.2 Summary of the empirical findings	171

List of figures

Figure 3.1 Structure of the literature review	37
Figure 3.2 The asset-exploiting/augmenting function as mediator between O and L advantages and FDI	72
Figure 3.3 Asset exploitation and augmentation within the envelope paradigm framework	76
Figure 4.1 Conceptual framework	104
Figure 5.1 Four paradigms for the analysis of social theory	109
Figure 5.2 The social research process	111
Figure 5.3 Research instrument.....	115
Figure 6.1 Entry mode in relation to the age of the HTSME.....	156
Figure 6.2 Entry mode in relation to the size of the HTSME.....	157
Figure 6.3 Entry mode in relation to the HTSME's international experience.....	157
Figure 6.4 Entry mode in relation to industry.....	158
Figure 6.5 Entry mode in relation to the host country	159
Figure 6.6 Type of FDI in relation to HTSME age	160
Figure 6.7 Type of FDI in relation to HTSME size	161
Figure 6.8 Type of FDI in relation to the HTSME's international experience	161
Figure 6.9 Type of FDI in relation to the industry	162
Figure 6.10 Type of FDI in relation to the host country.....	163

List of abbreviations

BGs	-	born globals
BMBF	-	Bundesministerium für Bildung und Forschung
CMB	-	common method bias
CME	-	coordinated market economy
EU	-	European Union
FDI	-	foreign direct investment
GDP	-	gross domestic product
HTSME	-	high-technology small and medium-sized enterprise
IFM	-	Institut für Mittelstandsforschung
INVs	-	international new venture
KBV	-	knowledge-based view
LME	-	liberal market economy
MNE	-	multinational enterprise
OECD	-	Organisation for Economic Co-operation and Development
OLS	-	ordinary least square
R&D	-	research and development
RBV	-	resource-based view
SME	-	small and medium-sized enterprise
TCT	-	transaction cost theory
UK	-	United Kingdom
US	-	United States
VIF	-	Variance Inflation Factors

1 Introduction

1.1 Background of the research

The strategic development of SMEs is fundamental to the growth of industrialised countries (European Commission, 2013). The reason is that in contrast to large MNEs, SMEs keep the majority of their operations and employment in their home market (Fryges, 2009). In the European Union (EU) in 2013, 99.8% of all firms were SMEs. These employed 66.5% of the working population and contributed 57.6% to the combined GDP (European Commission, 2013). Similar patterns emerge when looking at Germany, the country under investigation in this study. In 2013, 99.6% of all firms were SMEs (IFM, 2013a). These employed 59.5% of the working population and contributed around 54.8% to the GDP in 2011 (IFM, 2013a). These figures show that SMEs are the backbone of many industrialised countries, as they constitute the fundamental force behind economic output, employment, and social welfare (Seifert, 2010). Therefore, due to the major impact of SMEs on economic development and equitable distribution of wealth, the analysis of SME development is a focal point of academic, political, and managerial interest.

This study is specifically interested in the FDI activities of high-tech SMEs (HTSMEs). In particular, it investigates ownership and location factors related to the HTSMEs' asset-exploiting and asset-augmenting FDI. As the research is conducted in the context of Germany, the study follows the SME definition of the German Institute for Medium-Sized Enterprise Research (IFM, 2013b). It defines a SME as a firm with less than 500 employees and annual revenue of less than €50 million. The SMEs under investigation in this study operate in high-tech industries, which are defined as industries that operate on the technology frontier developing cutting-edge innovations. These industries apply highly advanced expertise and equipment to develop products, which are the newest of their kind (European Commission, 2010; Piva et al, 2013; Schweitzer and Di Tommaso, 2008). The asset-exploiting FDI of the HTSMEs is defined as the internalisation of a foreign operation in

order to transfer and exploit existing firm-specific advantages (such as differentiated products, the knowledge or control of a more efficient production function, the ability to acquire production factors at a lower cost and better distribution facilities). Thus, the firm is able to create economic rents abroad (Buckley and Casson, 1976; Hymer, 1976). The asset-augmenting FDI is defined as the internalisation of foreign operations in order to gain access to complementary or new knowledge-intensive assets. Thus, the firm is able to integrate these knowledge-assets to enhance its existing firm-specific assets (Buckley and Hashai, 2009).

The engagement of HTSMEs in these two types of FDI is specifically interesting for several reasons. The globally rising demand for high-technology products and the subsequent emergence of knowledge-intensive ventures are “an engine for job creation, innovation, and regional development” (Chen et al., 2009:294). Currently, several industrialised and mature economies such as Germany still rely on medium-tech manufacturing capabilities, e.g. the automotive industry (Allen et al, 2011). However, high-tech industries have proven to be a major growth engine for these economies over the last years (European Commission, 2012). HTSMEs contribute to this growth by generating a significant share of their revenues through their foreign operations (European Commission, 2012). On the specific example of Germany, annual high-tech exports in 2011 were worth \$183.4 billion. This is the second highest in the world behind China (\$457.1 billion) and before the United States (\$145.3 billion) (World Bank, 2013). However, similar to other European governments, the German government is aware that other regions such as e.g. the Silicon Valley in the US have been growing more rapidly in the high-tech sector due to a more dynamic local innovation system (Federal Ministry of Education and Research, 2010). Hence, global knowledge sourcing through internationalisation and asset-augmenting FDI can be a significant strategy for HTSMEs to remain competitive in a globalised market.

Therefore, several government initiatives were introduced to stimulate the entrepreneurial and competitive activities of high-tech firms in the EU. For example, a key focus of the European Union's 'Europe 2020 Strategy' is to enhance the role of science, innovation and technological progress of knowledge-intensive firms among its member states (European Commission, 2014). Moreover, in the specific case of Germany, the government introduced the 'Hightech-Strategy for Germany until 2020' in 2006. Its aim is to develop general conditions to enhance the cooperation of science and industry and to stimulate the entrepreneurial and competitive activities of German high-tech firms to create potential lead markets (Federal Ministry of Education and Research, 2010). These government initiatives introduced above create opportunities for the development of skilled labour and employment and contribute to economic growth and welfare. This applies for an economic and political union such as the EU as well as for individual countries such as Germany.

HTSMEs gain from such political initiatives as they support the firms in the establishment of a strong foundation in their home country. Nevertheless, scholars claim that a strong domestic base is just a prerequisite to operate successfully in global markets and to sustain long-term success (Fryges, 2009). SMEs in the high-tech sector additionally need to gain first mover advantage into new markets to exploit new technologies before competitors (Li et al, 2012). Furthermore, the firms need to explore and augment specific location bound knowledge and capabilities around global lead markets (De Maeseneire and Claeys, 2012). Otherwise, if HTSMEs fail to enter global networks, supply chains and financial markets, they are likely to experience problems in the development and commercialisation of competitive products (Qi, 2008). Several scholars support this argument claiming that increased participation in international markets is essential for the competitiveness and survival of HTSMEs (Van Geenhuizen and Nijkamp, 2012; Kenny and Fahy, 2011; Musteen et al, 2013). Therefore, the FDI activities of HTSMEs are an important emerging subject within the field of HTSME internationalisation research.

Theoretical approaches to study the FDI of HTSMEs are vast in the extant literature. Traditional SME research has mainly focused on non-equity entry modes such as export, partnerships and cooperation. Thus, SME studies have applied theoretical approaches such as stage approaches (Bilkey and Tesar, 1977; Johanson and Vahlne, 1977). Studies that are more recent have built on the international entrepreneurship concepts of born-global firms and international new ventures (McKinsey and Company, 1993; Oviatt and McDougall, 1994). Moreover, current SME research has adopted the resource-based view (Wernefelt, 1984) respectively the knowledge-based view (Kogut and Zander, 1993) and the network theory (Johanson and Mattsson, 1987). However, theoretical approaches pertaining to the FDI of MNEs such as the internalisation theory (Buckley and Casson, 1976) and the OLI paradigm (Dunning, 1988) have gained little attention in the context of HTSMEs. Nevertheless, these theories are becoming increasingly important to study the international activities of HTSMEs. As Li et al (2013:4) suggest, “The internalization theory has important implications for small, young technology based firms and their early internationalization.” Furthermore, Rammer and Schmiele (2008:6) highlight that “Research on internationalisation of SMEs is of course strongly influenced by theories on the multinational enterprise and the determinants of foreign direct investment.”

Therefore, this study is particularly interested in the applicability of the envelope paradigm framework, the most current update of Dunning’s OLI paradigm, in the new context of the FDI of HTSMEs for several reasons. The updated paradigm (Dunning, 2000; 2003; 2004; Dunning and Lundan; 2008) incorporates the strategic-asset seeking FDI motivation, which explicitly concerns the firm’s quest to acquire new and complementary knowledge and capabilities across borders (Buckley and Hashai, 2009 Narula and Santangelo, 2012). Hence, the paradigm is suitable to explain the organisation of supplementary assets to increase the future performance of the firm, which has been identified as highly significant for internationalised HTSMEs (Fernhaber et al, 2009; Van Geenhuizen and Nijkamp, 2012;

Haeusler et al, 2012; Li et al, 2011). Furthermore, the theories embraced under the envelope paradigm's umbrella such as internalisation theory, resource-based approaches, location theory and network theory have been individually validated as relevant in empirical research on international activities of HTSMEs (this claim will be extensively corroborated in the literature review of this study). Hence, it is deemed suitable and interesting to investigate the applicability of the envelope paradigm to study the FDI of HTSMEs.

This investigation is of high significance, as the fields of international business and international entrepreneurship have not been able to clearly distinguish a specific theory or framework to explain the increasing engagement of HTSMEs in equity-entry modes (Colombo et al, 2009; Li et al, 2011, 2013; Spence et al, 2008; Zapkau et al, 2013; Zou and Ghauri, 2010). This development of HTSMEs from domestic entities mainly engaged in export and cooperation towards internationally active entities engaging in resource intensive market entry modes has been recently described by several authors (De Maeseneire and Claeys, 2012; Dimitratos et al, 2014; Li et al, 2011; Li et al, 2013). In order to advance knowledge in this upcoming field, this study critically challenges the updated version of an established IB framework to evaluate if its explanatory power holds in the new context of the FDI of HTSMEs. In order to underpin this quest, the following section (1.2) specifically elaborates on the FDI of HTSMEs. Subsequently, section 1.3 outlines the research gap addressed in this study. Section 1.4 elucidates the contribution to knowledge achieved by this study, followed by the statement of the research aim and objectives of the empirical investigation in section 1.5 and the research questions in section 1.6. Section 1.7 provides the definitions of the key terms used in this study and section 1.8 outlines the structure of the study.

1.2 HTSMEs and FDI

Casson and Godley (2010) propose that vertical integration allows HTSMEs to expand internationally by exploiting their innovative advantage over larger firms. This is an important aspect as HTSMEs are not able to compete with large MNEs in scale and scope. Hence, the authors suggest that HTSMEs should undertake FDI in order to internalise at least some of the international activities to protect their innovations and maintain growth. Schwens et al (2011) corroborate this argument by emphasising that the advantage of FDI for HTSMEs over less resource intensive entry modes such as cooperation is the reduction of the costs of losing knowledge. Furthermore, internalisation allows the HTSME to coordinate and control its operations and to strengthen its market power (Li et al, 2013). However, resource scarcity due to the liability of smallness is still a main drawback for HTSMEs to engage in FDI (De Maeseneire and Claeys, 2012; Li et al, 2011). Furthermore, the first period after the establishment of a foreign subsidiary is often characterised by low or negative profitability due to the liability of foreignness (Coombs et al, 2006). HTSMEs might not be able to survive this period due to their limited resources (Kuivalainen et al, 2012).

Therefore, HTSME managers have to evaluate carefully the advantages and disadvantages of equity entry and non-equity entry to foreign markets (Schwens et al, 2011). Possible strategies could be illustrated in a matrix with the axes 'level of control' and 'mode of entry' (Pinho, 2007). This matrix has been a commonly used tool for managers and researchers to evaluate foreign market entry strategies for large established MNEs (Anderson and Gatignon, 1986). Although the firm characteristics of these large MNEs differ to those of HTSMEs, both types of firms are equally exposed to the same international market forces, problems and challenges of the globalised business environment (Dimitratos et al 2014; Di Gregorio et al, 2009; Ruzzier et al, 2006). Thus, the traditional borderlines between SMEs and MNEs have started to vanish. Kuepfer (2010) suggests that aspects of the FDI theory,

which explains the existence of MNEs, also apply for SMEs. Brouthers and Nakos (2004:244) conclude, "...we found that transaction cost theory appears to be applicable to the entry mode choice of SMEs. Transaction cost relationships identified in previous large firm studies tend to apply to SMEs as well." This argumentation is in line with several scholars who have outlined that in the current business environment many SMEs are small MNEs as they operate internationally, employ foreign capital, people and processes and often create the majority of their revenues abroad (Aggarwal et al, 2011; Di Gregorio et al, 2009; Li et al, 2011).

This emerging phenomenon of small MNEs has increasingly gained attention in the field of international business. For example, several scholars have investigated the nature and behaviour of 'micro-multinational firms' (Dimitratos et al, 2003; 2010; Ibeh et al, 2004; Wheeler et al, 2009). In a similar vein, scholars studied international technology-based SMEs and referred to them as 'infant multinationals' (Lindqvist, 1991; 1997; Narula, 2012), 'small multinationals' (Ripolles and Blesa, 2012) and 'smaller technology-based multinationals' (Cantwell and Narula, 2001). This paradigm shift in SME research is based on the increasing engagement of SMEs in equity entry modes, which have traditionally been seen as entry modes reserved for larger well-established MNEs (Li et al, 2013).

Fillis (2001) suggests that small MNEs can coexist besides large MNEs because of their ability to offer customised products and services and their entrepreneurial innovative capabilities, which can be exploited through intuitive network formation (Coviello, 2006). In a similar vein, Aggarwal et al (2011:557) propose, "while MNCs remain a central focus of IB research, these developments have broadened research agendas and extended the range of firms that qualify as MNCs." Pertaining to SMEs, they tend to have a higher R&D productivity due to their ability to utilise and exploit knowledge developed outside the firm (D'Angelo, 2010). This gives them a behavioural advantage over MNEs, which in turn

possess material advantages (Di Gregorio et al, 2009). Therefore, international business scholars have to reconsider the established view of SME activities in the global market. Future research should proceed beyond traditional SME entry modes with little resource commitment, such as export, cooperations partnerships to more resource intensive forms of foreign commitment such as equity joint ventures and wholly owned subsidiaries (Abidi et al, 2011; Almor and Hashai, 2002; Li et al, 2013; Schwens et al, 2011).

For example, the establishment of a wholly owned subsidiary abroad can enable HTSMEs to tap into location bound assets in order to explore new knowledge in the form of distinctive products, processes and capabilities (Franco, 2013; Kenney et al, 2009). This claim is in line with Zou and Ghauris' (2010:239) characterisation of the HTSME internationalisation process, which they describe as "a process with increasing knowledge exploited, acquired, internalized and applied in firms' subsequent international market entries." The effects of globalisation leverage this process and enable HTSMEs to overcome resource constraints and other drawbacks to internationalisation. Therefore, a new mindset in international business literature has arisen comprising the 'death of distance' and the 'end of geography' (Buckley and Ghauri, 2004). However, this does not mean that location does not matter anymore; it is just a different approach to location, which now engages IB scholars. Globalisation has made it easier than ever before for HTSMEs to go beyond export as a mode of entry and become involved in more resource intensive forms of foreign engagement (Di Gregorio et al, 2013; Li et al, 2013). Thus, in recent years, HTSME ownership strategies and entry modes have become more complex including international networks, joint ventures and FDI (Al-Laham and Souitaris, 2008; Nummela and Saarenketo, 2011).

However, empirical evidence related to the FDI of HTSMEs is scant. Previous empirical investigations of HTSMEs have predominantly concerned the accelerated internationalisation process of HTSMEs (e.g. Cannone and Ughetto 2014; Crick, 2009; Li

et al, 2012; Maine et al, 2010; Melen and Nordmann, 2009; Zou and Ghauri, 2010). This branch of literature suggests that young HTSMEs pursue a route of rapid internationalisation due to an intensification of competition in the knowledge-based global economy, where innovation, market adaptability and development and exploitation of technologies are fundamental for the firms' competitiveness and long-term success (Haeusler et al, 2012). The international entrepreneurship branch summarises this fast growing body of literature. It tries to explain the phenomenon of small firms, which follow a rapid and dedicated route of internationalisation immediately or shortly after inception, often referred to as 'born-global firms' (McKinsey and Company, 1993) or 'international new ventures' (Oviatt and McDougall, 1994).

Yet, empirical investigation of HTSMEs in the overlapping fields of international business and international entrepreneurship has mainly concerned the internationalisation process of HTSMEs. The focus of empirical investigation has been on the export behaviour, cooperations, partnerships and joint ventures of HTSMEs. However, little is known about the asset-exploiting and asset-augmenting FDI activities of HTSMEs. Nevertheless, current HTSME research shows that asset-exploiting and asset-augmenting FDI have gained prominence on the agenda of researchers, managers and policy makers (Abidi et al, 2011; Di Gregorio et al, 2009; Li et al, 2013; Zapkau et al, 2013). Furthermore, the previously discussed research stream of micro multinational firms reflects the increasing interest in this topic. Therefore, in order to advance knowledge in this under researched field, this study investigates the asset-exploiting and asset-augmenting FDI activities of HTSMEs.

1.3 Statement of the gap

The gap addressed in this study relates to the lack of a comprehensive theory or framework to study and explain the different types of FDI of HTSMEs. As previous HTSME studies have outlined, commonly adopted theories and frameworks in HTSME internationalisation

research do not have sufficient explanatory power to account for the relevant aspects related to the FDI of HTSMEs (Bell et al, 2003; Child and Rodriguez, 2005; Dimitratos et al, 2014; Li et al, 2011; 2013; Melen and Nordman, 2009; Ojala and Tyrväinen, 2008). For example, the traditional internalisation theory adopted from the international business field is only partly relevant in the HTSME context. It over-emphasises the transaction cost construct where conventional production MNEs integrate operations as a response to market failure. Hence, it covers efficiency seeking and market seeking reasons for FDI and partly neglects the strategic asset seeking reason, which is a key FDI motivation for HTSMEs (Abidi et al, 2011; Li et al, 2013; Ito and Wakasugi, 2007; Iwasa and Odagiri, 2004). As Abidi et al (2011:336) emphasise, “the shortcoming of internalisation theory with respect to the FDI explanation lies in its incapacity to underline cross-border knowledge-creation as a fundamental issue in a global SME’s survival.” Previous studies underpin this argument by pointing out that HTSMEs often locate in local knowledge clusters and technological lead markets to explore new assets, rather than to exploit existing assets by minimising transaction costs (Al-Laham and Souitaris, 2008; Dimitratos et al, 2010; Rammer and Schmiele, 2008). Hence, within the context of HTSMEs, an appropriate FDI framework needs to incorporate the firm’s motivation to engage in FDI to organise future knowledge assets. Here lies another drawback of internalisation theory in the context of HTSMEs as Coviello and McAuley (1999:225) claim, “internalisation theory is used primarily to explain a pattern of investment (in terms of its extent, form, and location of international production), and not a long term process of international expansion.” Therefore, a gap persists, as the traditional internalisation theory is not particularly sufficient to explain the different types of FDI of HTSMEs.

Stage approaches have been another commonly adopted theory in the past to explain SME internationalisation (Ruzzier et al, 2006). However, these approaches show significant weaknesses in explaining the FDI of HTSMEs as they follow a generalised trajectory of a

simple sequential internationalisation process of the SME (see e.g. Johanson and Vahlne, 1977; Bilkey and Tesar, 1977; Cavusgil, 1980). Thus, stage approaches comprise a very deterministic nature of SME internationalisation (Hennart, 2009; Morgan and Katsikeas, 1997; Ruzzier et al, 2006). However, SME internationalisation in the current business environment is a highly complex process, which includes choice (Hutzschenreuter et al, 2007), interpretation (Daft and Weick, 1984) and collective social interaction (Emirbayer, 1997). Accordingly, the deterministic and incremental stage approaches are of lower relevance in the context of internationalised HTSMEs. These firms operate on a global scale, often shortly after inception, in industries which are extremely dynamic and fast changing (Braennback et al, 2007; Cannone and Ughetto, 2014; Parida et al, 2012). Hence, the psychological and cultural distance concepts, which are key concepts in stage approaches, seem to be less relevant in HTSME context (Oviatt and McDougall, 1999). Therefore, the theoretical underpinnings of stage approaches are less sufficient to provide a suitable framework to study the FDI of HTSMEs.

Similarly, the more recent international entrepreneurship (IE) approach fails to narrow the gap under investigation for several reasons. First, its main concepts, the ‘born-global’ firm (McKinsey and Company, 1993) and the ‘international new venture’ (Oviatt and McDougall, 1994) fail to provide a framework to investigate the underlying reasons and motivation of HTSMEs to undertake FDI. They rather explain the rational of HTSMEs to engage in less equity intensive foreign entry modes such as export, partnerships and cooperations (Crick, 2009; Shrader, 2001). Second, the IE concepts do not account for firm specific resources, which enable the HTSME to particularly engage in FDI. Instead, they account for firm specific resources connected to the less equity intensive entry modes listed above. Third, from a geographical perspective, IE does not specifically incorporate location factors, which determine the HTSME’s decision to undertake FDI in a specific location. It views locations from the perspective of lead and niche markets, where firms export to, or collaborate in, with

a minor focus on location factors associated with FDI (Cannone and Ughetto, 2014; Gassmann and Keup, 2007). Therefore, the IE field fails to provide a theoretical framework to study HTSMEs, which have already undertaken FDI.

Other relevant approaches in IB research adopted from the field of strategic management, such as the resource-based view (RBV), knowledge-based view (KBV), or dynamic capabilities perspective, are only able to explain certain aspects of FDI by HTSMEs, but fail to provide an all-embracing framework. For example, the RBV (Peng, 2001; Penrose, 1959; Wernerfeld, 1984) is sufficient to explain the organisation of assets to maintain the firm specific competitive advantage, but it lacks to account for the underlying mechanisms of accessing and integrating these assets into the firm, especially on an international scale. As the RBV seeks to explain sustainable competitive advantage, several scholars described it as too static and tautological for firms operating in highly dynamic business environments, such as HTSMEs (Barreto, 2010; Priem and Butler, 2001; Saarenketo et al, 2004; Williamson, 1999).

Nevertheless, knowledge resources were outlined as crucial for the international competitiveness of HTSMEs (Fernhaber et al, 2009, Filatotchev et al, 2009; Liu et al, 2010). Hence, the KBV (Grant, 1996; Kogut and Zander, 1992) is suggested by many researchers as a valuable perspective to study the foreign knowledge generation of HTSMEs (Van Geenhuizen and Nijkamp, 2012; Qi, 2008; Saarenketo et al, 2004; Yli-Renko et al, 2002). Additionally, based on the KBV, the dynamic capabilities perspective provides a complementary approach to explain the firm's ability to absorb, form and reconfigure competitive advantage as a response to changes in the market (Teece et al, 1997). Nevertheless, in consideration of the underlying research problem, the KBV and dynamic capabilities perspective have to be treated as complements to an overall framework explaining the different types of the FDI of HTSMEs. They are valuable perspectives to

discuss the knowledge enhancing capabilities of the firm, but they lack theoretical underpinning in terms of internalisation of operations and cross-border transactions. Furthermore, these approaches pay little attention to location aspects in the international business environment. This might be due to the origin of the approaches in the field of strategic management rather than international business.

Similar to the KBV and dynamic capability perspective, network theory has often been successfully adopted from the strategic management field to research in international business. Current empirical HTSME internationalisation studies have emphasised that network relations are a key explanatory variable in the internationalisation trajectory of HTSMEs (Van Geenhuizen and Nijkamp, 2012; Haeusler et al, 2012; Ojala, 2009; Tolstoy and Agndal, 2010). However, scholars have also acknowledged that network theory on its own is not sufficient to cover all relevant aspects of HTSME internationalisation. The reason is that it over emphasises on the effects of networks in international activities while it pays little attention to other major factors such as the firm specific ownership and internalisation advantages (Coviello and McAuley, 1999; Smolarski and Wilner, 2005). As Ruzzier et al (2006:485) highlight, “the strength of the network model of internationalization lies in explaining the process rather than the existence of multinational or international firms.” Thus, network theory can complement an overall framework to explain the FDI of HTSMEs, but on its own, it is too limited to cover all relevant aspects.

In contrast to the rather specific network theory, Dunning’s eclectic paradigm (1977; 1988) is a comprehensive IB framework to explain the extent and pattern of FDI activities in the context of large production MNEs. In this specific context, it has been a dominant research framework for more than three decades (Cook et al, 2011; Eden and Dai, 2010). The paradigm consists of three parameters; the ownership (O), location (L) and internalisation (I). These answer “different questions about international production. O explains why firms

engaged in international production; L explains where they went; and I, how they organized their international activities” (Eden and Dai, 2010:28). Hence, the eclectic paradigm meets several relevant criteria to provide an all-embracing FDI research framework. However, due to its simplistic configuration with a sole focus on large manufacturing MNEs and foreign production, it is misleading in a study of FDI in the context of knowledge-intensive HTSMEs. This type of firm differs to large production MNEs in the structure of its ownership advantages and the underlying reasons to locate abroad, which are knowledge development and small-scale distribution rather than low-cost production (Maine et al, 2010; Zou and Ghauri, 2010).

A more promising approach to narrow this gap could be the adoption of the envelope paradigm (Dunning, 2000; 2003; 2004; Dunning and Lundan, 2008). The envelope paradigm is a further development of the eclectic paradigm (Dunning, 1977, 1988), in response to the dynamics of the globalised and increasingly knowledge intensive business environment (Cantwell and Narula, 2001; Narula, 2010). However, literature lacks a critical evaluation of the applicability of the envelope paradigm outside its original context, the FDI of large MNEs, based on a theoretical discussion and tested through an empirical study. Therefore, a valid evaluation of the suitability of the envelope paradigm in the new context of the different types of FDI by HTSMEs remains elusive. In fact, the envelope paradigm is more complex than its predecessor with a specific focus on the dynamic ownership advantages such as knowledge assets, network relations and dynamic capabilities, which are crucial in for the FDI of HTSMEs (De Jong and Freel, 2010; Fernhaber et al, 2009; Li et al, 2011).

Furthermore, the envelope paradigm framework incorporates location advantages, which are highly relevant in the context of FDI. From a HTSME perspective, both traditional location factors (cost and market factors) and location factors related to knowledge aspects (technological and institutional factors) seem to be highly significant (Zou and Ghauri,

2010). The envelope paradigm provides a framework to examine these location factors in association with the relevant dynamic ownership advantages and the advantages achieved through the internalisation of operations. Therefore, the envelope paradigm can be seen as an umbrella for context specific theories. As Cantwell and Narula (2001:155) summarise, “We find that the paradigm continues to provide a framework which facilitates how best to synthesise relevant complementary theories, or how to choose between potentially competing theories, and helps to operationalize them.”

Therefore, the envelope paradigm is employed in this study as a starting point to provide a common ground to narrow the gap under investigation. It draws the attention of the researcher to the most relevant theories and frameworks to investigate an underlying research problem (Arvanitis and Hollenstein, 2011). Nevertheless, in the specific case of the FDI of HTSMEs, it remains unclear if the configuration of the envelope paradigm, which was originally developed to explain the FDI of large MNEs, can be specified and altered in order to account for the particular characteristics of HTSMEs and high-tech industries¹. Therefore, this study seeks to narrow the outlined gap by testing the suitability of the envelope paradigm framework to explain the different types of FDI of HTSMEs, based on the findings of a quantitative survey. The following section describes how this study contributes to the knowledge in the field.

¹ See section 2.2 and section 2.3 for particular characteristics of high-tech industries and HTSMEs

1.4 Contribution to knowledge

This study endeavours to contribute to international business and entrepreneurship literature on a theoretical, empirical and managerial level. In terms of theory development, this study contributes by critically evaluating if the envelope paradigm can serve as an analytical framework for understanding the different types of FDI of HTSMEs. Theoretical advances in this new research field are required as previous investigations do not determine a particular theory or framework to explain the FDI of HTSMEs sufficiently (as discussed in section 1.3 ‘Statement of the gap’). Therefore, this study tests if the application of an IB framework in an entrepreneurial context can overcome the theoretical vacuum. Within this process, it identifies the shortcomings of previously adopted theories and frameworks in HTSME internationalisation research and suggests strategies how to overcome their theoretical drawbacks.

Thereby, this study contributes to the interdisciplinary debate on the compatibility and suitability of IB and international entrepreneurship literature. This intersection of both research paths has been discussed in previous studies (Coviello and Jones, 2004; Keupp and Gassmann, 2009; McDougall and Oviatt, 2000; Peiris et al, 2012). Several authors have claimed that researchers should adopt a more holistic and integrated approach to study the international activities of SMEs (Coviello and McAuley, 1999; Kuivalainen et al, 2012; Ruzzier et al, 2006). However, the authors were not able to provide an adequate theoretical solution for their claim. Hence, the proposed research advances the field as a commonly acknowledged theory or framework remains elusive. As Mejri and Katsuhiko (2010:157) summarise, “There is still a need for models that succeed to integrate the main findings of previous literature.” Subsequently, current research faces the challenge of accommodating and integrating relevant theoretical approaches in one research design to study and explain the diverse and comprehensive nature of the FDI of HTSMEs. Therefore, this study contributes to the interdisciplinary debate by testing if the envelope paradigm framework is

able to incorporate and explain the relevant aspects of the FDI of HTSMEs. It further develops the understanding by drawing on sets of O and L-advantages specifically configured to the new, emerging and under researched field of the FDI of HTSMEs. This should provide a common ground for further research and stimulate additional empirical investigations.

On the empirical level, this study contributes in several ways. First, based on a quantitative survey design this study provides coherent statistical data regarding the full range of chosen foreign market entry modes of the entire HTSME population of two analogous industries in one country. This is an important advancement of empirical literature as previous HTSME studies have only focused on less resource intensive entry modes such as export (e.g. Filatotchev et al, 2009; Love and Ganotakis, 2012; Pla-Barber and Alegre, 2007), international partnerships (e.g. Chen et al, 2009; Coombs et al, 2006; Sawers et al, 2008) or strategic alliances (e.g. Fernhaber et al, 2009; Freeman et al, 2006; Haeusler et al, 2012). To the knowledge of the author, only two studies have collected and analysed empirical data on the FDI activities of HTSMEs (Li et al, 2011; Li et al, 2013). The advantage of this study is that the targeted sample population contains all nanotech and biotech SMEs in one country. Thus, the study is able to unveil the full range of chosen entry modes of HTSMEs including export, contractual agreements and FDI. More importantly, the analysis will allow to draw conclusions about the relationships between HTSME characteristics and entry mode choice. This is a significant advancement of the understanding of HTSME entry mode choice. Furthermore, as the nanotech and biotech industries are representative for all high-tech industries (see section 2.2), this study contributes to the empirical literature concerning internationalisation in technology industries.

Second, in the terms of the FDI activities of HTSMEs, this study is the first to provide empirical data about the extent of asset-exploiting and asset-augmenting FDI activities of

HTSMEs. Furthermore, based on the analysis of customised sets of O and L-advantages, the study provides a comprehensive overview of advantages enabling and driving the asset-exploiting and asset-augmenting FDI activities of HTSMEs. Yet, theoretical implications about the FDI of HTSMEs have been derived from related studies of large MNEs. Therefore, this study contributes to a refined understanding by providing more HTSME specific data, which allows a more accurate and rigorous analysis of this upcoming topic.

The third empirical contribution relates to the O and L-advantages in international business literature. The flexible nature of the conceptual framework adopted in this study allows for the large amount of O and L-advantages available in empirical FDI literature to be narrowed down to the relevant advantages in the specific context of FDI and HTSMEs. This advances literature as it supports the development of specific sets of O and L-advantages in the growing field of FDI and SMEs. Additionally, from a location perspective, the study adds to the innovation system literature, which is the fourth empirical contribution. The HTSMEs under investigation are all located in Germany, which has been described in literature as an incremental innovation system where rapid innovation is not promoted in the same manner as e.g. in Anglo-Saxon countries (Hall and Soskice, 2001; Kaiser und Prange, 2004). As this study investigates the extent of the exploitation and augmentation of home country advantages abroad, results will provide new insights regarding the international competitiveness of an innovation system that is classified as a ‘coordinated system’ (Hall and Soskice, 2001). Therefore, the country context of Germany allows to derive conclusions about other industrialised countries that are classified as a coordinated innovation system. This contributes to the literature concerning the context of developed countries that have not been seen as conducive to high-tech development. The fifth contribution stems from the perspective of the empirical investigation. In previous international business research, the vast amount of FDI studies has collected primary data from foreign subsidiaries. In contrast, this study approaches FDI from the perspective of the parent company. Thus, by

investigating FDI from a different research angle, this study adds new insights to empirical literature as it incorporates the relevant headquarters perspective, which has been partly neglected in the past.

1.5 Research aim and objectives

The gap in literature outlined above shows the lack of a theory or framework that is able to explain the FDI of HTSMEs. Therefore, based on the intended contributions to knowledge, the overall aim of this study is to explore if the envelope paradigm can serve as an analytical framework for understanding the different types of FDI of HTSMEs. In line with this research aim, the study seeks to achieve the following research objectives:

- 1) To critically assess the existing theoretical and empirical literature on international activities of HTSMEs
- 2) To investigate differences in firm characteristics between
 - HTSMEs engaging in non-equity entry modes and HTSMEs engaging in FDI
 - HTSMEs engaging in asset-exploiting FDI and HTSMEs engaging in asset-augmenting FDI
- 3) To investigate the relevance of HTSME specific ownership advantages and the importance of country specific location advantages related
 - to the asset-exploiting FDI of HTSMEs
 - to the asset-augmenting FDI of HTSMEs
- 4) To achieve the research objectives by analysing unique primary quantitative data based on a novel data set of German parent companies
- 5) To develop managerial and policy implications derived from the empirical results

1.6 Research questions

Based on the research aim and objectives of this study (section 1.5) and the stated gap in the literature (section 1.3), this section outlines the research questions to be answered in this study.

- 1) To what extent do HTSMEs undertake FDI and non-equity entry modes?
 - a) How do firm characteristics differ between HTSMEs that undertake FDI and HTSMEs that engage in non-equity entry modes?
 - b) In which countries/regions do HTSMEs undertake FDI?
- 2) What is the extent of asset-exploiting and asset-augmenting FDI of HTSMEs?
 - a) How do firm characteristics differ between HTSMEs that undertake asset-exploiting FDI and HTSMEs that engage in asset-augmenting FDI?
 - b) In which countries/regions do HTSMEs with asset-augmenting FDI and HTSMEs with asset-exploiting FDI invest?
- 3) Which O-advantages are relevant to the asset-exploiting and asset-augmenting FDI of HTSMEs?
- 4) Which L-advantages are important for the asset-exploiting and asset-augmenting FDI of HTSMEs?
- 5) Can the envelope paradigm serve as an analytical framework for understanding the FDI of HTSMEs?
- 6) Which policy and managerial implications can be derived from this study?

1.7 Definition of key terms

SME

“SMEs are non-subsidary, independent firms which employ fewer than a given number of employees. This number varies across countries” (OECD, 2005). This study follows the official governmental definition in the context of Germany. It classifies small enterprises as

firms that employ up to nine employees and generate up to one million € revenue per year and medium-sized enterprises as firms that employ up to four hundred ninety-nine employees and generate up to fifty million € revenue per year (IfM, 2013b).

High-tech

High-tech sectors comprise a high amount of non-repetitive processes during the value creation in contrast to standardised mass production. They are characterised through a high degree of scientists and engineers and a high innovative output per employee (Anselin et al, 1997; Malecki, 1984; Mudambi, 2008).

FDI

“Foreign direct investment (FDI) is the category of international investment that reflects the objective of a resident entity in one economy to obtain a lasting interest in an enterprise resident in another economy” (OECD, 2008:22).

Types of FDI

This study distinguishes between asset-exploiting FDI and asset-augmenting FDI following Dunning (2000). See below for the specific definitions.

Asset-exploiting FDI

The asset-exploiting FDI perspective “views FDI as the transfer or exploitation of firm-specific advantage and assumes that firms should possess certain forms of rent-yielding resources when investing in a host country” (Makino et al, 2002:404). In particular, the market seeking, resource seeking and efficiency seeking FDI motivations are categorised under the asset-exploiting FDI perspective.

Asset-augmenting FDI

The asset-augmenting FDI perspective views FDI as a foreign investment to access and acquire strategic assets (such as technological, marketing, and management skills) in order to enhance existing firm-specific assets or to create new firm-specific assets (Dunning, 2000;

Kuemmerle, 1999a; Rugman, 2010). In particular, the strategic asset seeking FDI motivation is categorised under the asset-augmenting FDI.

O-advantages

O-advantages are defined as unique and sustainable firm-specific capabilities and assets, which provide the firm with a competitive advantage over its competitors in a foreign country (Arvanitis and Hollenstein, 2011; Dunning, 2000; Verbeke and Yuan, 2010).

L-advantages

L-advantages are defined as advantages that “represent potential gains a firm can realize by optimizing its activities along the value chain across locations” (Arvanitis and Hollenstein, 2011:609).

1.8 Structure of the dissertation

This section outlines how the remaining chapters are organised and the logic of the overall argument is subsequently developed. Chapter 2 sets the study in the specific context of SMEs, high-tech, internationalisation, FDI and Germany. It provides the background information for these key aspects in this study. The literature review in chapter 3 provides a comprehensive and critical review of the relevant schools of thought and theories in the specific HTSME internationalisation context. Thus, it provides the foundation for a critical evaluation of the suitability of the introduced theories and frameworks for this study. This evaluation is further enriched by a comprehensive analysis of the existing empirical literature in HTSME internationalisation research. Finally, the chapter presents a synthesis of the findings of the literature review and relates them to the outlined gap. This leads to chapter 4, which presents an envelope paradigm framework as the conceptual framework for this study. It determines the relevant ownership and location factors for the different types of FDI and outlines the research hypotheses for the empirical investigation. Accordingly, chapter 5 presents an appropriate methodology to operationalise the envelope paradigm

framework presented in chapter 4. It justifies why a scientific realist perspective and a quantitative research design is the most appropriate approach to investigate the different FDI types of HTSMEs. Furthermore, it presents the specific research tool adopted and provides an operationalisation of the key constructs. Chapter 6 contains the data analysis providing answers to the research questions. It commences with the descriptive statistics providing information on the entry mode and types of FDI chosen by HTSMEs. This is followed by the diagnostics for the regression models and the regression results elucidating the ownership and location factors relevant to the different types of FDI of HTSMEs. These results are discussed in chapter 7. It examines if the proposed envelope paradigm framework holds and links the specific research findings back to theory. Thus, it provides a discussion of how the underlying findings relate to previous knowledge in the field. Finally, chapter 8 outlines how the findings of this study contribute to theory and how they extend existing knowledge in the field. It further provides political and managerial implications derived from the results of this study. The chapter commences with a reflection on the limitations of the study and suggestions for further research in the specific field.

2 Research context

This chapter elaborates in detail on the context of the study. The following sections provide background information for the key aspects in this study. It commences with discussion of SMEs (section 2.1), proceeds with high-tech and high-tech industries (section 2.2), HTSMEs (section 2.3), HTSME internationalisation (section 2.4) and ends with a discussion of the German context (section 2.5). This enables the reader to gain a broader understanding of the subjects under investigation and to place the research in the wider context.

2.1 SMEs

The characteristics of what defines a SME differ between countries. A very general definition is provided in the official glossary of the OECD: “SMEs are non-subsidary, independent firms which employ fewer than a given number of employees. This number varies across countries” (OECD, 2005). As German HTSMEs are the unit of analysis for this research, the study adopts the official SME definition of the German governmental institute for SME research, the ‘Institut für Mittelstandsforschung’ called IfM. It follows a twofold approach: small enterprises are classified as firms that employ up to nine employees and generate up to one million € revenue per year. Medium-sized enterprises are classified as firms that employ up to four hundred ninety-nine employees and generate up to fifty million € revenue per year (IfM, 2013b). This is a standard definition of German SME policy and has been adopted by other studies of German SMEs (Rammer and Schmieie, 2008). Table 2.1 summarises the adopted SME classification in this study.

Table 2.1 SME classification

Firm size	Number of employees	Revenue € / year
Small	up to 9	up to 1 million
Medium	up to 499	up to 50 million
Small and Medium combined	below 500	below 50 million

Empirical investigations in the SME context are very important for several reasons. SMEs have traditionally been the catalysts for progress, development, and economic growth and have therefore a significant impact on the economic performance of a country (Zeng et al, 2010). A key factor of their success is the ability to respond quickly to innovative change. As D'Angelo (2010:394) outlines, "...smaller firms with fewer routines and less bureaucratic resistance have the ability to adapt to environmental changes more easily, which makes them more prone to provide innovations compared to their larger counterparts." This claim is in line with findings of Rosenbusch et al (2011) who outline that SMEs tend to have a higher R&D productivity due to their ability to utilise and exploit knowledge developed outside the firm. This ability provides them an advantage over larger MNEs. Furthermore, findings of current research highlight that SMEs have less bureaucratic structures, a lower degree of organisational inertia, are able to react faster to changing demand and have a higher tendency to take risks (Parida et al, 2012; Schwens et al, 2011). Hence, SMEs seem to be better innovators than large MNEs. This claim follows Schumpeter's concept of creative destruction (Schumpeter, 1934; 1942). It predicts destruction for established firms that fail to innovate while new creative firms will take over their place and fuel long-term economic growth. The creative destruction concept has gained high attention in contemporary entrepreneurship research. Many scholars outlined that small innovative firms are agents of change who proactively target the market shares of long established competitors by developing highly innovative products and processes (Keupp and Gassmann, 2009).

Traditional international business literature viewed SMEs as domestically operating firms that engage to a certain degree in export. Thus, SMEs were clearly distinguished from MNEs, which were seen as large mature corporations that have internationally adjusted their operations and strategy (Mejri and Umemoto, 2010; Parrilli, 2008). However, as the effects of globalisation have diminished the influence of scale as a critical requirement for being internationally active, SMEs can operate on the same scale as MNEs (Aggarwal et al, 2011;

Kenney et al, 2009). As Aggarwal et al (2011:1) propose, "... these developments have broadened research agendas and extended the range of firms that qualify as MNCs." Thus, in the current business environment, it is problematic to differentiate between SMEs and MNEs when looking at their international operations (as discussed in chapter 1.2). Therefore, it appears that contemporary international business literature is not able to distinguish clearly the attributes characterising a SME and MNE.

2.2 High-tech and high-tech industries

In order to conduct an in-depth study of HTSMEs, it is essential to scrutinise the connotation of the term 'high-tech' to set the study in a precise context. However, high-tech is an ambiguous term of which academic literature provides different definitions and classifications. For example, Anselin et al (1997) provide a very broad demarcation of the high-tech sectors by suggesting that they comprise a high amount of non-routine functions in contrast to standardised mass production. These sectors are characterised through a high degree of scientists and engineers and a high innovative output per employee. In a similar vein, Mudambi (2008) builds on the conceptualisation of Malecki (1984) highlighting that a high number of specialised non-repetitive processes during the value creation are a key determinant of knowledge-intensive industries. Several other empirical studies investigating high-tech industries such as ICT or biotech have taken for granted that these industries are high-tech industries and have not provided a specific definition of high-tech or high-tech industries (see Johnson, 2004, Kenny and Fahy, 2011, Zou and Ghauri, 2010). Other studies of high-tech industries relied on governmental classification schemes or referred back to previous studies that have discussed the nature of high-tech industries (see D'Angelo, 2010; Spence and Crick, 2006; Zahra et al, 2000).

This study follows the high-tech definition provided by the European Commission. It categorises high-tech into three comprehensive approaches: the sector approach, the product

approach, and the patent approach. The sector approach considers the high-tech manufacturing sector and high-tech knowledge-intensive service sector. Its key focus is on the employment measures and economic indicators such as number of enterprises, turnover, value added etc. The product approach distinguishes between high-tech and non high-tech products and examines trade patterns of these products. Finally, the patent approach defines high-tech patents and delineates these patents from non high-tech patents (European Commission, 2010). Through the adoption of this threefold definition, this study is able to approach the high-tech concept in a highly comprehensive way by drawing on it from different angles. Thus, the study provides a complete picture of the subject.

Regarding high-tech industries, they are reliant on intangible knowledge-assets and intellectual capital (Piva et al, 2013; Schweitzer and Di Tommaso, 2008). The firms in high-tech industries operate on the technology frontier developing cutting-edge innovations. They apply highly advanced expertise and equipment to convert resources into outputs, which are usually the newest of their kind (European Commission, 2010). High-tech industries are high-velocity environments characterised through uncertainties due to rapid technological change, complicated regulatory processes and unpredictable demand patterns. Furthermore, available information and technological knowledge in high-tech industries become quickly obsolete. Therefore, firms in these industries must be highly flexible and effective in recognising and adjusting to new unpredicted changes in their business environment (Piva et al, 2013).

In the particular case of Germany, the ministry for education and research uses the R&D intensity to demarcate the high-tech sector. It sets the threshold for R&D expenditure in turnover at >7% for the high-tech sector. In comparison, R&D expenditure in the medium-tech sector lies between 2.5% and 7% while it lies below 2.5% for the low-tech sector (Legler and Frietsch, 2007). Typical high-tech industries are biotechnology, nanotechnology,

information and communication technology, medical technology, and materials and advanced manufacturing technologies (Mudambi, 2008; OECD, 2010; Tolstoy and Agndal, 2010; Zou and Ghauri, 2010). High-tech industries are dependent on global supply chains with key markets in the triad region of Europe, North America and Japan. However, emerging economies such as the BRIC countries become increasingly important high-tech markets (European Commission, 2010; Ficarek and Veloso, 2010). On the international scale, firms in high-tech industries commonly seek to protect their intangible superior knowledge-assets through the internalisation of transactions and markets (Buckley and Casson, 2009). The high governance mechanism allows them to safeguard their extensive R&D investments and the knowledge gained during long product development cycles (Li et al, 2013). This seems highly important, as international competition is very high in high-tech industries. The reason is that high-tech industries facilitate international expansion better than other industries, as they are non-culture bound. Operational procedures and product characteristics seem to be equal across different countries and do not require major adjustment to diverse cultural settings (Wu and Lin, 2010).

As a result, there has been an increasing intensification of competition on a global scale, over the last decades. Many countries have shifted production structures from low-tech towards high-tech manufacturing and more knowledge-intensive and specialised services due to structural changes and government initiatives (Mudambi, 2008; OECD, 2009). As suggested by Hall and Soskice (2001), a prerequisite for the development of high-tech industries in a country is the existence of an institutional environment, which encourages and supports advanced research and product development. The promotion of high-tech industries positively affects an economy as it supports the creation and accumulation of competitive advantages e.g. highly skilled workforce and the establishment of specialised supportive networks (Parrilli, 2008; Schweitzer and Di Tommaso, 2008). Particularly industrialised economies rely on their high-tech industries developing cutting-edge

technologies (Hatem, 2011). The reason is that industrialised economies cannot compete with emerging economies in terms of input costs such as low labour costs (Jensen and Pedersen, 2011). Hence, future economic success and growth of industrialised economies is highly dependent on the development of high-tech industries and the development of products, which require specific non-imitable knowledge and capabilities (Mudambi, 2008; Parrilli, 2008).

The nanotech and biotech industries are particular industries that fulfil the high-tech criteria outlined above. Therefore, the empirical data analysed in this study was gathered from SMEs in these two industries. This had several advantages. The nanotech and biotech industries are considered to be at the forefront of high-tech industries and both share similar industrial characteristics (OECD, 2010; Rampersad et al, 2010). For example, both industries are entrepreneurial and populated by many SMEs (Gassmann and Keupp, 2007), truly global (Pla-Barber and Alegre, 2007), innovative and rapidly changing (Allen et al, 2011). Hence, international knowledge sourcing through different entry modes is highly significant for nanotech and biotech SMEs (Haeusler et al, 2012). Therefore, SMEs from these industries are a highly suitable unit of analysis for the underlying investigation.

2.3 HTSMEs

Typical HTSMEs operate in global lead and niche markets selling their advanced products and constantly seeking new capabilities (Cannone and Ughetto, 2014; Crick, 2009; Kenny and Fahy, 2011). Thus, HTSMEs are a major force behind radical innovation and the development of future technologies (Li et al, 2013). As Jones (1999:20) summarised, “Among the main concerns for technology-based firms is the development and exploitation of their technology, which may mean technology transfer at various stages in the innovation process, and the augmentation of their resource base.” Therefore, in comparison to SMEs operating in other economic sectors, HTSMEs need to possess a higher degree of firm-

specific attributes such as an advanced knowledge base, higher capabilities in technological development, an educated workforce, and the ability to adapt quickly to fast changing environments (Cannone and Ughetto, 2014; Keupp and Gassmann, 2009). The vast majority of high-tech firms in the context of Germany are small and medium-sized enterprises while there are only a few large players in the high-tech sector (Federal Ministry of Education and Research, 2014a; 2014b).

One reason is that many high-tech firms are spin-offs from universities and other research institutes (Clarysse and Wright, 2011; Gassmann and Keupp, 2007). These firms are often established by a scientist entrepreneur who employs a small group of specialised co-workers he/she has previously worked with in a research setting. They start with a single scientific discovery and develop it until it is ready for the market. As high-tech industries are truly global, young HTSMEs internationalise quickly into foreign markets to commercialise their products, disregarding the cultural distance of the market (Juho and Mainela, 2009). Nevertheless, as the final output of HTSMEs is highly knowledge-based rather than manufactured, effects of scale economies usually remain modest. On the other hand, due to their lean structure, HTSMEs avoid diseconomies of scale as experienced by larger and non-high-tech firms when innovation and product introduction to the market are slowed down through bureaucracy and the corporate system (Audretsch and Stephan, 1996). HTSMEs often maintain their lean structure for an extensive period after inception. The reason is the high tendency to outsource certain activities, which lie beyond the scope of the firm and require highly specialised external knowledge (Dana et al, 2007; Narula, 2012). This can happen in form of informal agreements, cooperations or equity investments in other scientific firms (Narula, 2004). Moreover, HTSME managers are often natural scientists who lack managerial capabilities in accounting and marketing. Hence, outsourcing of these activities is an attractive option (Schweitzer and Di Tommaso, 2008).

The development of new HTSMEs is often stimulated by financial incentives provided by governments to young dynamic entrepreneurs. In the case of Germany, the government has introduced in 2010 a new program called EXIST (Existenzgründung aus der Wissenschaft) to support the foundation of new HTSMEs as part of the overall High-tech Strategy 2020, which was introduced earlier in this study (Federal Ministry of Economics and Technology, 2010). HTSMEs require this increased governmental attention and financial support in comparison to SMEs in other sectors. The reason is that HTSMEs have to face higher R&D costs and uncertainties of the commercial viability of the final product due to regulations in many industries, especially in biotech or medical supplies (Al-Laham and Souitaris, 2008; Braennback et al, 2007; Cleff et al, 2007; Gassmann and Keupp, 2007). Besides the governmental support, venture capitalists, a ‘parent’ firm, or private investors often provide financial support for HTSMEs (Schweitzer and Di Tommaso, 2008). However, investments in HTSMEs bare the risks of highly variable returns, asymmetric information and lack of collateral (DeMaeseneire and Claeys, 2012). The lifecycle of HTSMEs is very fragile. Investments can be multiplied in a short amount of time or be completely lost due to failure (Li et al, 2013). This development often depends on the HTSME’s ability to sell its products on international markets. Therefore, following section discusses the internationalisation of HTSMEs in more detail.

2.4 HTSME internationalisation

HTSMEs are predominantly affected by the increasing global integration of markets (Cannone and Ughetto, 2014). Jones et al (2009) suggest that the increasing importance of the knowledge economy stimulates the emergence of HTSMEs, whose risk-seeking behaviour and firm strategy is likely to drive early and rapid international involvement. Accordingly, the vast majority of HTSMEs internationalise their operations, the only uncertain variable is the point in time of internationalisation (Cannone and Ughetto, 2014;

Mazzarol, 2007). Empirical research has also shown that HTSMEs apply more resource intensive modes of entry and internationalise more rapidly than non high-tech SMEs (Crick, 2009; Li et al, 2011; Maine et al, 2010). Some studies suggest the reason is that firms from the high-tech sector operate internationally in order to regain high investments during the innovation process (Stoian and Fillippaiosa, 2008). Another explanation is that HTSMEs need to protect proprietary knowledge that provides a competitive advantage against opportunistic behaviour of alliance partners (Li et al, 2011; Schwens et al, 2011).

However, HTSME internationalisation is a complex process. Firms have to face well-acknowledge drawbacks to foreign market entry. These are constraints of financial and other physical resources, susceptibility to financial risks, legal insecurities, regulatory burdens, lack of developed administrative and control systems, increased institutional distance and minor organisational capabilities (Dimitratos et al, 2009; Juho and Mainela, 2009; Mazzarol, 2007; Zucchella et al, 2007). Accordingly, on the one hand, HTSME internationalisation can be hindered through resource constraints. On the other hand, internationalisation can enable the HTSME to obtain resources from external foreign sources to overcome previous limitations. Furthermore, the individual character and personal experience of the HTSME owner manager or general manager can be an influencing force of HTSME internationalisation (Kuivalainen et al, 2012). Some authors suggest that attitudes, individual preferences and personal business relations of managers are determinants of HTSME internationalisation strategy (Lloyd-Reason and Mughan, 2002; Pinho, 2007).

2.5 Background of Germany

Germany is a particularly suitable setting for a study of the FDI of HTSMEs as the national background specifically suits this topic. In particular, Germany has been the 4th largest investor of outward FDI from 2008-2012. The highest share of foreign investment went to the US, UK, Benelux and France, which are key markets in the high-tech sector (OECD,

2013). Furthermore, Germany has an above average share of high- and medium-high-tech SMEs (1.6%) in comparison to other EU 27 states (1.2%) (European Commission, 2012). In general, it can be characterised through its high share of SMEs. For example, in 2010 99.6% of all firms were SMEs (IfM, 2013a). These employed 60.2% of the German working population and contributed 51.8% of the country's net value-added (IfM, 2013a). Currently, Germany still relies on its medium-tech manufacturing capabilities, e.g. the automotive industry (Allen et al, 2011; Reiss and Hinze, 2004). However, in recent years the German government has developed policies to support domestic high-tech industries, which has increased the international competitiveness of German high-tech firms (BMBF, 2013).

This was an important initiative as Germany has been an unfavoured location for high-tech industries such as biotech or nanotech before the turn of the century as it was not conducive to high-tech industries (Hall and Soskice, 2001). As Al-Laham and Souitaris (2008:574) point out "Hampered by a hostile regulatory environment for genetic research throughout the 1980s and early 1990s and facing additional institutional constraints, the German biotechnology industry was de facto nonexistent prior to the mid 1990s". Today, the German biotech and nanotech industries are the largest and most developed in Europe (Haeusler et al, 2012). Therefore, this study is able to derive conclusions from a comparatively large sample of HTSMEs, which enhances the reliability of the findings.

Despite the positive development of German high-tech industries, the German market economy is still considered to be coordinated with an innovation system that is supportive for incremental innovation rather than radical innovation (Hall and Soskice, 2001). For example, German HTSMEs have to face high innovation costs and a shortage of highly skilled labour with a particularly skill set for certain activities (Federal Statistical Office, 2012; Rammer and Schmiele, 2008). Hence, German firms could overcome this home country drawback by engaging in innovative activities in foreign locations (Rammer and

Schmiele, 2008). From another perspective, HTSME internationalisation occurs in response to increasing domestic and global competition. Firms seek to leverage foreign location advantages in order to enhance or create new competitive advantages (Rammer and Schmiele, 2008). Most German SMEs engage in export while less information is available regarding the firms' engagement in more resource intensive foreign entry modes. Previous research has shown that German firms are more cautious about internationalisation, specifically in terms of foreign R&D (Ambos, 2005).

3 Literature review

3.1 Structure of the literature review

The unit of analysis differs in internationalisation research depending on the political and economic stance of the researchers (Dunning and Lundan, 2008). Hence, the first section of the literature review introduces the different schools of thought in order to locate this study in the theoretical context (section 3.2). This discussion is taken forward in a critical evaluation of the international entrepreneurship approach for this study (section 3.3) and a justification why the international business school seems to provide the most suitable tools to address the underlying research topic (section 3.4). Subsequently, the subsections of 3.4 critically discuss and evaluate the explanatory power of relevant IB and strategic management theories and frameworks to investigate the FDI of HTSMEs. The findings of this discussion are synthesised at the end of the section leading to a justification for the underlying research aim of this study: To test if the envelope paradigm can serve as an analytical framework for understanding the FDI of HTSMEs. Accordingly, the eclectic paradigm is introduced and discussed in-depth (section 3.4.5). The chapter ends with a synthesis of the literature review (section 3.5).

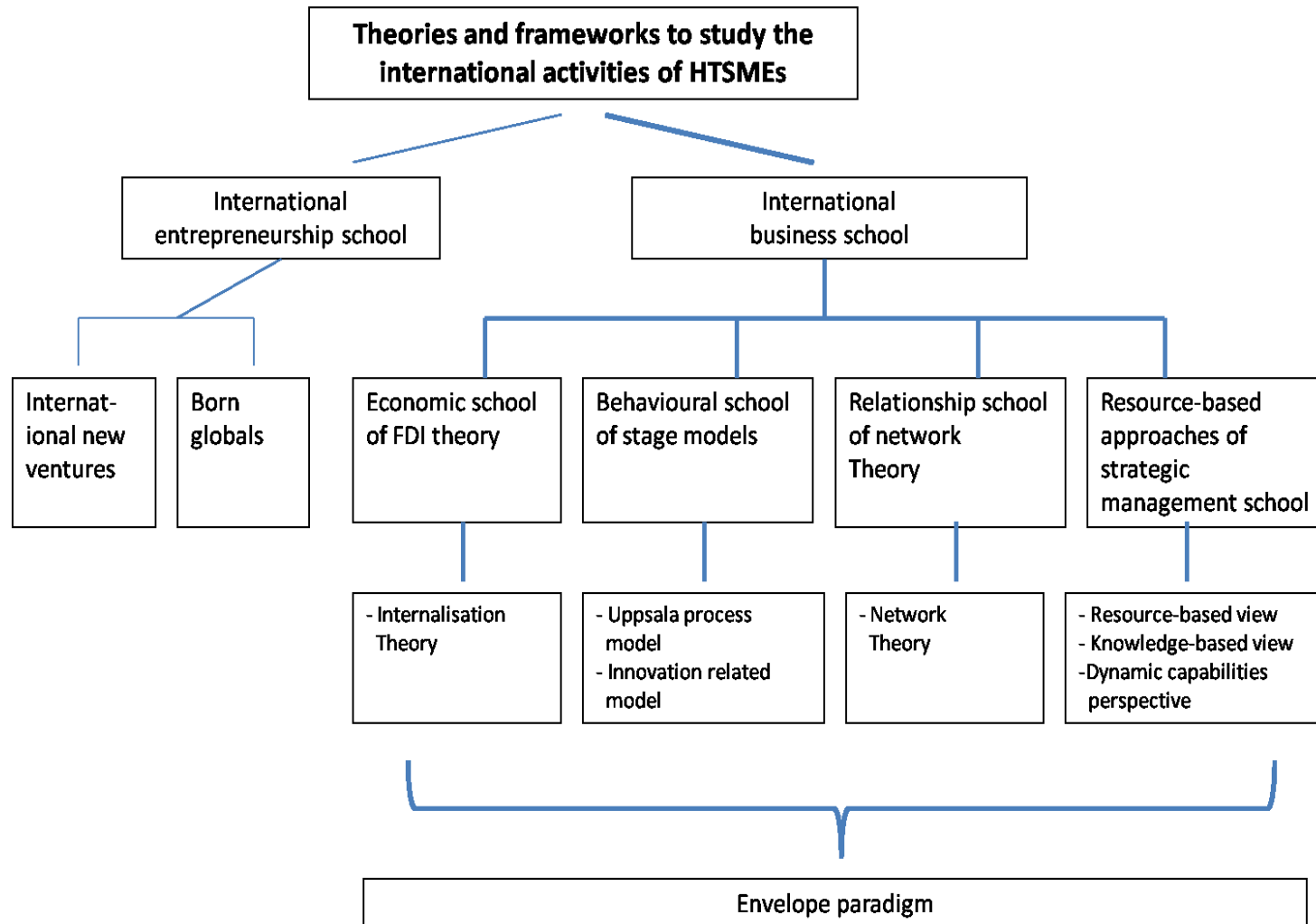
3.2 Schools of thought

This section briefly introduces the relevant schools of thought for this study in order to place this investigation in the right context. From the perspective of traditional Marxist political economists, internationalisation is a mechanism in a capitalist environment to leverage the monopolistic position of either the investing firm or country (Hymer, 1972; Newfarmer, 1985). This focus on a monopolistic position applies for large well-established MNEs. However, it does not grasp the underlying nature of small internationalised HTSMEs. A different approach to internationalisation is provided by business analysts and organisational theorists. Its interest lies in the factors that influence the decision making process of a firm to invest in a foreign location (Ghoshal and Westney, 1993). However, this decision making

process is not in the focus of this study as it is rather interested in how HTSMEs organise their existing foreign investment.

In between these two approaches, the macro-economic school of thought can be located (Dunning and Lundan, 2008). It incorporates a wider perspective concerning the explanation of countries engagement in FDI, the emergence of MNEs and international patterns of production, consumption and trade (Buckley and Hashai, 2009; Dunning and Lundan, 2008). However, the macro-economic approach does not account for the firm-level perspective of HTSMEs and the underlying relationships between their knowledge-specific advantages and the associated location-specific advantages of the host country. Therefore, the macro-economic perspective seems less suitable for this study. Hence, the following sections critically evaluate two more promising approaches to address the foreign activities of HTSMEs, the international entrepreneurship school (section 3.3) and the international business school (section 3.4). The evaluation contains an in-depth discussion of the analytical tools related to both schools. This discussion follows a common thread. First, the theoretical foundation of each theory/framework is introduced. Second, its strengths and weaknesses to explain and understand the FDI of HTSMEs is evaluated. Third, the empirical evidence is summarised in a table containing all empirical HTSME internationalisation studies, which have adopted the theory/framework under investigation. Figure 3.1 outlines the overall structure of the literature review and visualises the different streams leading to the embracing envelope paradigm

Figure 3.1 Structure of the literature review



3.3 International entrepreneurship

3.3.1 Introduction

The international entrepreneurship (IE) field is an intersection of the two research paths of international business and entrepreneurship (Keupp and Gassmann, 2009; McDougall and Oviatt, 2000). Its interest lies in young business organisations that show from inception proactive and risk-seeking behaviour across national borders (Jones et al, 2011). Therefore, the IE approach suits generally very well to the profile of HTSMEs as the purpose of these firms is to create value and to exploit and increase their competitive advantage in multiple countries (Peiris et al, 2012). However, from a theoretical perspective, the IE literature is fragmented and lacks a unifying paradigm (Jones et al, 2011; Kuivalainen et al, 2012). In recent empirical studies, the most commonly adopted IE concepts have been the born-global firm (BG) introduced by McKinsey and Company (1993) and the international new venture (INV) introduced by Oviatt and McDougall (1994). An INV is defined as a “business organisation that, from inception, seeks to derive significant competitive advantage from the use of resources and the sale of outputs in multiple countries” (Oviatt and McDougall, 1994:49). In comparison, a BG firm is defined as a business organisation, which achieves a significant international presence within two years after inception (McKinsey and Company, 1993). These two seminal definitions have been the most commonly adopted in research concerning the early internationalisation of HTSMEs (as summarised in Table 3.1).

A second and considerably smaller research stream in IE literature concerns the international expansion of so-called born-again globals. These are SMEs, which commence a delayed internationalisation process after having been well established in their domestic market for an extended period (Bell et al, 2001). This delayed internationalisation can be triggered by a management buyout, the need to increase sales in new markets in order to cover debt repayments, the firm’s acquisition by new financiers who request internationalisation as a condition for further financial investment or the overcoming of resource constraints that have

been a drawback to internationalisation in the past (Bell et al, 2001; McNaughton and Bell, 2000). Having introduced the relevant IE concepts for the underlying research context, the following sections discuss the advantages and disadvantages of adopting an IE approach as a conceptual frame to investigate the FDI of HTSMEs.

3.3.2 Strength and weaknesses of IE concepts in HTSME internationalisation research

The findings of the literature review summarised in Table 3.1 show that the IE concepts have mainly been adopted in empirical HTSME studies concerning the accelerated and dedicated internationalisation process of young firms (see column ‘research subject’). This reflects the overall strength of IE concepts, which lies in the explanation of the factors influencing HTSMEs’ early and rapid internationalisation. The synthesis of the findings of the investigated studies reveals the main strength of IE concepts: To provide a conceptual foundation to understand HTSME internationalisation in terms of timeframe of internationalisation, mode of foreign entry and accelerated international expansion (see column ‘main findings’). In particular, several of the investigated studies provide straightforward conclusions regarding the internationalisation process of young HTSMEs (e.g. Al-Laham and Souitaris, 2008; Love and Ganotakis, 2013; Renko et al, 2009; Styles and Genua, 2008). Other studies suggest that the mode of foreign market entry can differ significantly between HTSMEs due to unspecified sets of internal and external of circumstances (e.g. Braennback et al, 2007; Buergel and Murray, 2000; Hashai, 2011; Johnson, 2004; Melen and Nordman, 2009). In summary, the empirical findings outlined in Table 3.1 highlight that the IE concepts are useful tools to conduct a study of the timeframe and process of internationalisation of young HTSMEs.

However, IE concepts do not provide a conceptual approach to study the underlying reasons of HTSMEs to engage in FDI and to distinguish between asset-exploiting and asset-augmenting activities in the host country. As Table 3.1 outlines, no single HTSME study in

IE has undertaken an empirical investigation in either of these two research areas, which are in the key focus of this study. Hence, IE concepts do not provide the conceptual and theoretical underpinnings suitable to the underlying research problem. Furthermore, the unit of analysis in IE literature is either young entrepreneurial firms (INVs and BGs) or established firms that pursue a delayed route of internationalisation (born-again globals). However, this study is interested in the entire German nanotech and biotech HTSME population, disregarding the firms' age or timeframe of its internationalisation. Its focus lies on the HTSMEs' FDI to exploit and explore foreign assets. Thus, this study targets HTSMEs, which have already internalised foreign operations rather than HTSMEs, which are in the process of organising their internationalisation. Accordingly, the IE concepts do not conform to the underlying research problem of this study. A more relevant approach seems to be provided by the international business theory as it is primarily interested in the internalisation of foreign operations. Therefore, the following sections introduce and discuss commonly adopted theories and frameworks in international business research in order to determine a suitable theoretical foundation for this study.

Table 3.1 Empirical HTSME studies adopting international entrepreneurship perspective

Author/s (Year)	Research subject	Method	Sample	Main findings
Al-Laham and Souitaris (2008)	Internationalisation of German biotech firms: The impact of inter-organisational factors on the likelihood of the formation of international research alliances.	Secondary archival data, event history analysis	853 German biotech INVs	International relationships can already be achieved by locating in a local cluster. The likelihood of a firm's formation of international research alliances increases when the firm engages in alliances with local partners or research institutes and by the establishment of a central position in the local R&D community/network.
Braennback et al (2007)	Fundamentals of the born-global firm.	Mixed-method approach, interviews, multiple industry cluster surveys, thematic analysis, non-parametric statistics	118 Finish biotech BGs	Localisation and globalization are major determinants of BG development. During the process of internationalization BGs should actively follow market oriented strategies.
Buergel and Murray (2000)	Entry mode choice of HTSMEs.	Survey based questionnaire, regression analysis	246 UK HTSMEs	Mode choice is a trade-off between available resources and customer support requirements. Additionally, the ability to create

				innovations and historic channel experience in the domestic market are significant factors.
Buerger et al. (2001)	Factors influencing the incidence of NTBF's internationalisation.	Mixed-method approach, survey based questionnaire, structured interviews, econometric analysis	40 German and UK NTBFs	Factors increasing the possibility of internationalisation are: the size of the firm at foundation, its age, regular R&D activities, international business experience of the founders.
Chen et al (2009)	Complex strategic choices through which INV growth is pursued and attained.	Interview-based questionnaire survey, regression analysis	238 Chinese high-tech INVs	Partnership growth results in higher product diversity and acquisition is more effective in realising firm internationalisation. Both support a higher chance of INV survival. Additionally, the authors elucidate the moderating effect of technological capability on the relationship between INV performance and growth strategies.
Coeurderoy and Murray (2008)	Effects of the regulatory environment on location choice and internationalisation speed.	Survey based questionnaire, regression analysis	375 UK and German HTSMEs	The regulatory environment (IPP) has an influence on the location choice of HTSMEs while it has less influence on the speed of internationalisation.
Fontes and Coombs (1997)	The development of NTBFs in less advanced countries and their role in the development and diffusion of technology.	Case-study approach, semi-structured interviews, content analysis	26 Portuguese NTBFs	Firms in that context highly contribute to the acquisition, absorption and dissemination of new technology.
Ganotakis and Love (2011)	The relationship between R&D, product innovation, and exporting of NTBFs.	Survey based questionnaire, regression analysis	412 UK NTBFs	Export activities are positively related to internal R&D, lagged productivity and supply-chain cooperations.
Gassmann and Keupp (2007)	Generation and protection of BG competitive advantage which facilitates early and rapid internationalisation.	Case studies, structured interviews, secondary data, content analysis	6 bio-tech BGs in Switzerland, Germany, Australia	Networks are major drivers as they present mechanisms to overcome resource deficiencies. Furthermore, a specialised position in the value chain enables firm internationalisation.
Gurau and Ranchhod (2006)	The internationalisation process of UK and US HTSMEs from the domestic market profile perspective.	Survey based questionnaire, descriptive statistics	566 UK and US biotech SMEs	UK firms engage more in internationalisation in order to overcome the drawbacks of their limited domestic market.
Haeusler et al (2012)	Benefits and risks of strategic alliances for high-technology new firms.	Survey based questionnaire, regression analysis	689 UK and German HTSMEs	The success of an alliance is dependent on the firms' alliance experience and its financial situation.
Johnson (2004)	Factors influencing the early internationalisation of high-tech start-ups.	Mixed-method approach, interviews and content analysis, survey based questionnaire and descriptive statistics	106 UK and US high-tech start-ups	Factors influencing early internationalisation are international orientation of the founder, desire to be international market leader, international opportunities and international contacts.
Jones (2001)	Exploration of a series of related sub models covering	Survey based questionnaire,	213 UK HTSMEs	For HTSMEs, trade related activities are the most common. 50% of the firms include value

	different stages and dimensions of HTSME internationalisation.	descriptive statistics		chain activities other than trade in their first internationalization steps.
Karagozoglu and Lindell (1998)	Motives, barriers and strategies of HTSME internationalisation.	Survey based questionnaire, descriptive statistics	34 US HTSMEs	In terms of strategy, firms seek to prepare for a successful internationalisation. For motives and barriers no uniform patterns were found.
Love and Ganotakis (2013)	The effects of exporting on the innovation performance of HTSMEs.	Survey based questionnaire, regression analysis	412 UK HTSMEs	Export supports the firm's innovation but does not increase the intensity of innovation.
Melen and Nordman (2009)	Internationalisation modes of BGs – continued internationalisation.	Case study approach, semi-structured interviews, cross-case analysis	8 Swedish biotech BGs	BGs use a vast variety of internationalisation modes. It is impossible to provide a blueprint for BG internationalisation.
Nordman and Melen (2008)	The effect of BGs founder's and manager's previous knowledge on the detection and utilisation of foreign expansion opportunities.	Case study approach, semi-structured interviews, archival secondary data, cross-case analysis	8 Swedish biotech BGs	Uncommon to previous research, BGs should not be seen as a homogenous group. There are different types of BGs, which pursue different routes of internationalisation.
Nummela et al (2004)	The company boundaries of internationalising HTSMEs in terms of accelerated resources and skills acquisition.	Survey based questionnaire, regression analysis	124 Finish ICT SMEs	A higher number of partners delays the internationalisation process. However, it has a positive effect on the rapidity of internationalisation. Additionally, the study found an association between core competence and rapid internationalisation.
Renko et al (2009)	The influences of market orientation, entrepreneurial orientation, and technological capabilities on INVs' innovativeness.	Interview based survey, structured interviews, regression analysis	85 US, Finish, Swedish biotech INVs	Technological capability has a significant impact on innovativeness. Market orientation and entrepreneurial orientation do not impact innovativeness.
Shrader (2001)	Exploration of factors moderating the relationship between collaboration activities of INVs and their performance in foreign markets.	Mixed-method approach, structured interviews, secondary archival data, regression analysis	70 US high-tech INVs	Important moderators between INV collaboration and performance abroad are the R&D intensity and advertising intensity.
Spence (2003)	International strategy formation of HTSMEs in light of the time constraints to internationalisation.	Case study approach, semi-structured interviews, content analysis	8 Canadian HTSMEs	Emergent strategies within or outside existing networks trigger HTSME internationalisation. Resource constraints limit further internationalisation. Internationalisation should be seen from a holistic perspective.
Spence and Crick (2006)	Comparison between the internationalisation process of Canadian and UK HTSMEs.	Case study approach, semi-structured interviews, cross case analysis, secondary data analysis	12 Canadian and 12 UK HTSMEs	The internationalisation strategies in both countries are similar. Strategy formation as previously explained in other studies is limited – no theory could fully explain the whole process.
Spence et al (2008)	Internationalisation of HTSMEs in terms of	Case study approach, semi structured	8 Canadian HTSMEs	Successful performance of collaborative ventures is conditional on the circumstances

	collaborative ventures.	interviews, cross-case analysis		experienced by particular management teams. To measure the performance of a collaborative venture the commitment of each partner should be included besides process and outcome measures adjusted to the partners' objectives.
Styles and Genua (2008)	Effects of networks and entrepreneurial orientation on the internationalisation of firms originating from academic research.	Case study approach, interviews, observation, documentation, thematic analysis	4 Australian high-tech INVs	Academic networks support internationalisation. Risk taking, technological innovativeness and autonomy support entrepreneurship. Proactiveness and product-market innovativeness support international success.
Zahra et al (2000)	Effects of international expansion on technological learning and financial performance.	Survey based questionnaire, regression analysis, secondary data analysis	321 US high-tech INVs	There is a strong relationship between International diversity and entry mode, breadth, depth and INV's speed of learning.
Zahra et al (2003)	Effects of tangible and intangible technological resources on speed and extend of sales internationalisation.	Survey based questionnaire, regression analysis	786 US high-tech INVs	Intangible technological resources are positively related to the speed and extend of sales internationalisation.
Zou and Ghauri (2010)	Gradual and rapid internationalisation of Chinese high-tech INVs.	Case study approach, content analysis	3 Chinese high-tech INVs	The gradual or incremental internationalisation model is still valid – however, Chinese high-tech INVs are internationalising much faster than suggested by previous research. These firms do not pursue the route indicated by born global literature

3.4 The international business school

3.4.1 Introduction

The international business school seeks to explain the existence and growth of individual firms in the international market place (Dunning and Lundan, 2008). Its focal points of interest have traditionally been international market internalisation and cross-border intermediate production (Casson, 2013; Hennart, 1991; Rugman, 1981). Furthermore, its interest lies in the question why foreign firms are better able to manage valued-added activities abroad than indigenous firms (Dunning and Lundan, 2008). Hymer (1960; 1976) suggests that the investing firm must possess a monopolistic advantage in order to outperform indigenous firms in the foreign country. Building on this perspective, Dunning (1977, 1988) explains the rational for FDI and the existence of MNEs in a broader context

by combining economic theories of monopolistic competition, location advantages and transaction costs.

In general, the adopted approach and methodology for academic inquiry in the IB school has been strongly influenced by the modern transaction cost economics (Coase, 1937) and organisational theory (Williamson, 1985). Until the end of the last century, IB research mainly concerned the explanation of economic and behavioural internationalisation across borders. The unit of analysis has been large established MNEs with a strong resource base (Ruzzier et al, 2006; Saarenketo et al, 2004). As the analytical IB tools were developed to fit this kind of firm, they might not conform to a study of small SMEs, which differ in terms of firm characteristics and internationalisation trajectory. Therefore, the subsequent literature review evaluates the suitability of available IB theories and frameworks in the underlying research context, the FDI of HTSMEs. This commences with a determination of a suitable approach to firm internationalisation, which is used in the subsequent sections as a common thread to organise the critical discussion of the available theories and frameworks.

3.4.2 Approaches to internationalisation in SME research

There has been an on-going discussion in literature regarding the suitability of different IB approaches in SME internationalisation research. Comprehensive literature reviews are provided by Coviello and McAuley (1999), Dana et al (1999); Kuivalainen et al (2012); McAuley (2010), Miesenbock (1988) and Ruzzier et al (2006). Findings of these literature reviews commonly suggest that no single theory or framework is suitable to explain HTSME internationalisation sufficiently. The reason for this explanatory inability might be that scholars have adopted different approaches to internationalisation, which made it difficult to compare findings and to establish a common ground for future investigation. Therefore, several attempts have been made to synthesise the literature on internationalisation approaches (Andersen, 1993; 1997; Beamish, 1990; Johanson and Vahlne, 1990; Leonidou

and Katsikeas, 1996; Morschett et al, 2010; Reid, 1983; Ruzzier, 2006; Welch and Luostarinen, 1988). Based on the findings, it is possible to categorise three main approaches to internationalisation. The following paragraphs introduce these approaches and discuss their suitability in the underlying research context.

The first approach to internationalisation is quite broad and generally accepted in the research community. It stems from a geographical perspective and defines internationalisation as the expansion of a firm's operations across domestic borders (Turnbull, 1987; Wright and Ricks, 1994). This definition covers contributions of Beamish et al (1997) and Welch and Luostarinen (1988), who include the outward operations of the firm (foreign sales) and the inward operations of the firm (firm gains resources from abroad). As the focus of this study is solely on the outward of HTSMEs, a more refined approach to outward FDI appears to be more suitable for this study. Nummela et al (2005) outline a second approach to internationalisation. They draw on internationalisation as a growth strategy based on the work of Ansoff (1965), which implies market development as an expansion strategy of the firm. The firm seeks to expand into foreign markets to sell its existing products in order to extend market share and stimulate growth. However, Nummela et al (2005) highlight that little attention has been paid to the concept of growth in SME internationalisation research. Especially in research projects, which investigate the complex and dynamic high-tech sector, the concept of market development seems to be limited. As delineated in the context chapter (section 2.3), HTSMEs usually operate on a global scale from inception as they serve global niche and lead markets. Moreover, HTSMEs often expand into foreign markets in order to gain access to superior knowledge intensive assets to complement their existing knowledge base. Therefore, the traditional concept of market development is too simplistic and outdated in the context of HTSME internationalisation.

In contrast, the third internationalisation approach outlined by Coviello and McAuley (1999) seems to be more suitable for this study. It breaks internationalisation down into three different schools: The economic school of FDI theory, the behavioural school of the stage models and the relationship school of the network theory. The economic school of FDI theory holds that the decision to internalise operations across borders is based on a rational economic analysis of the firm's ownership advantages and the location advantages of the potential host country. If the firm undertakes FDI, the deployment of resources is configured towards a maximisation of the firm's profit and competitive advantage (Buckley and Casson, 2009; Dunning, 1977; 1988). The behavioural school follows a different approach. It holds that internationalisation is a feedback-reaction system in which decision makers respond to internal and external challenges of the firm. It views internationalisation as an incremental process of the firm's incremental commitment to foreign markets due to increasing experience, network relations and other contingent factors (Johanson and Vahlne, 1990). The relationship school, which builds on the behavioural school, emphasises the role of relations in networks established before and during the process of internationalisation. It holds that network relations have an impact on the future growth and expansion of the firm (Johanson and Mattsson, 1988). In summary, Coviello and McAuleys' (1999) approach to internationalisation seems to be the most suitable to study HTSME internationalisation. It allows to account for FDI patterns, network relations and behavioural aspects of SME internationalisation. Nevertheless, in order to cover all relevant aspects of HTSME internationalisation, this study extends Coviello and McAuleys' approach by including the resource- and knowledge-based approaches adopted from the strategic management school. Thus, the study is able to provide a highly comprehensive theoretical base to inquire internationalised HTSMEs. The following sections of the literature review critically discuss the theories and frameworks related to the different schools introduced above in order to justify the conceptual framework adopted in this study.

3.4.3 Relevant theories and frameworks in HTSME internationalisation research

3.4.3.1 Internalisation theory

Internalisation theory falls under the economic school of FDI theory. It draws on the work of Coase (1937) holding that market imperfections generate transaction costs, which the firm can minimise by organising interdependent activities under common ownership and governance (Buckley and Casson, 1976; Rugman, 1981). Its focus is on firms, which create internal markets in order to reduce the costs occurring from the use of external market mechanisms (Buckley and Casson, 2009; Rugman, 1981). Thus, the theory provides an explanation for the existence of the MNE and the organisation of its activities (Buckley and Casson, 2009). The internalisation theory is closely related to transaction cost economics (Williamson, 1985). Both approaches follow the reasoning of the integration of external operations. However, internalisation theory applies specifically to firms that internalise operations across national borders (Forsgren, 2008). Furthermore, while transaction cost theory relates to the willingness of a firm to internalise markets based on logic reasoning of minimising transaction costs, the internalisation theory relates to the actual capability of the firm to internalise markets (Rugman, 1981; Dunning, 1988).

Internalisation theory implies that the foundation of firm specific advantages is proprietary knowledge (Rugman, 1981). This knowledge can be transferred, deployed and exploited across national borders through the internalisation of markets (Buckley and Casson, 2009). Johanson and Vahlne (1990) point out that transaction costs are specifically high for technologically complex products, as it is the case for HTSMEs. Therefore, the “the propensity to rely on own sales organisations rather than agents are higher in firms with those kinds of products (Johanson and Vahlne, 1990:17). This argument is in line with the main findings of empirical HTSME studies that adopted internalisation theory summarised in Table 3.2. It shows that the reluctance of HTSMEs towards market-based exchange is greater when asset specificity increases.

Interestingly, Table 3.2 reveals that only five empirical HTSME internationalisation studies have drawn on internalisation theory. An explanation for its limited adoption could be the availability of other theories and frameworks that might be considered more suitable in the HTSME internationalisation context (see synthesis Table 3.8). Furthermore, it could be that resource deficiencies and limited foreign experience has hindered cross-border internalisation of HTSMEs in the past, which resulted in reduced academic attention. However, current empirical research suggests that internalisation is a considerable strategic option for HTSMEs to maintain internal control over their foreign operations (Li et al, 2013; Schwens et al, 2012). In summary, the studies outlined in 3.2 suggest that the theoretical underpinnings of internalisation theory are significant in the context of FDI and HTSMEs. The following section elucidates the strengths and weaknesses of the internalisation theory in light of the underlying research context.

Relevance of internalisation theory in HTSME research

The findings of the literature review revealed that only six HTSME internationalisation studies have specifically employed the internationalisation theory (see Table 3.2). A general explanation could be that the FDI activities of HTSMEs have not gained much scholarly attention in the past, as described in chapter 1. Pertaining to the suitability of internalisation theory in HTSME research, the literature review findings suggest that the theory is able to explain how HTSMEs organise institutional arrangements within the firm specific hierarchies to avoid the use of external market functions for foreign asset-exploiting activities (Table 3.2). Hence, its strength lies specifically in the explanation of the circumstances of backward vertical integration into resource extraction (Cantwell and Narula, 2001). With focus on the FDI of HTSMEs, Li et al (2013:4) found that “internalization theory provides significant implications for the internationalisation of HTSMEs”. It explains how HTSMEs can enhance profitability by undertaking certain

activities in least costs locations. Through the functions of internalisation, HTSMEs can exploit cost advantages while protecting their firm-specific knowledge against opportunistic behaviour of foreign partners (Li et al, 2013; Schwens et al, 2011).

The limitation of internalisation theory is its static in nature and its inability to explain the firm's organisation of future assets, especially with respect to the creation of new innovations (Dunning, 2000). As Cui and Jiang (2010:756) highlight, "The internalisation theory is effective in explaining the determinants of conventional type of FDI, i.e., the FDI carried out by Western MNCs for efficiency seeking and market seeking purposes." However, the theory seems too simplistic to explain the foreign knowledge asset seeking activities of HTSMEs (Majeed et al, 2011). Furthermore, internalisation theory does not account for the firm's relationship with the host country's institutional and social environment, a commonly known critical success factor of HTSME internalisation (Al-Laham and Souitaris, 2008; Ferro et al, 2009). As Dunning (2003:7) claims, internalisation theory can only explain "a number of relational specific costs and benefits - both in respect of FDI and alliances - it is less forthcoming in explaining the appropriate vehicle for identifying the contribution of relational assets to the innovatory or even the productive activities of firms - or indeed, of contribution of being part of a network of firms to the upgrading of firm specific relational assets."

This claim supports the argumentation of the reduced explanatory power of internalisation theory in HTSME research. Furthermore, the theory has been developed to account for transactional functions related to short-term profit maximisation. This short-term orientation contradicts the purpose of HTSME internationalisation, which is usually related to the establishment of foreign networks and relationships to access new knowledge and capabilities to organise future assets (Freeman et al, 2010; Gilbert et al, 2008; Maine et al, 2010). Nevertheless, Dunning (2000:180) claims, "this does not destroy the validity of

internalisation theory per se. It does, however, suggest that its contents should be widened to incorporate all costs and benefits associated with corporate activities; and not only those which are transaction related.” Hence, based on the above discussion and the findings summarised in Table 3.2, it appears that internalisation theory provides several relevant implications in the context of FDI and HTSMEs. However, it lacks certain important aspects, particularly in relation to the organisation of future knowledge-assets. Therefore, the following sections will critically discuss further theories and frameworks in order to provide a synthesised evaluation of relevant research approaches to investigate the FDI of HTSMEs.

Table 3.2 Empirical HTSME studies adopting internalisation theory

Author / Year	Research subject	Method	Sample	Main findings
Almor and Hashai (2004)	The relationship between HTSMEs’ superior R&D capabilities and inferior marketing and production capabilities.	Interview based questionnaire, semi-structured questionnaire, descriptive statistics	52 Israeli HTSMEs	HTSMEs internalise core capabilities (such as marketing or knowledge related activities) and externalise non-core capabilities (such as production activities). Inferior marketing activities are countervailed by specialisation in sales of low quantities of high-value products and services
Buergele et al (2001)	Factors influencing the incidence of NTBF’s internationalisation.	Mixed method approach, survey based questionnaire and case studies, structured interviews, econometric analysis	40 German and UK NTBFs	Factors increasing the possibility of internationalisation are: the size of the firm at foundation, its age, regular R&D activities, international business experience of the founders
Chen et al (2009)	Complex strategic choices through which INV growth is pursued and attained.	Interview based questionnaire, regression analysis	238 Chinese high-tech INVs	Partnership growth results in higher product diversity and acquisition is more effective in realising firm internationalisation. Both support a higher chance of INV survival. Additionally, the authors elucidate the moderating effect of technological capability on the relationship between INV performance and growth strategies.
Li et al (2011)	The effects of firm-specific advantages, country-specific advantages and degree of internalisation on HTSME performance.	Archival secondary data, panel data analysis (fixed-effects model)	51 US HTSMEs	Geographic dispersion affects SME performance negatively. Firm-specific advantages alleviate this negative impact while firm-specific marketing advantages mitigate it.

Li et al (2013)	The internalisation and externalization of transactions within the internationalisation process of HTSMEs.	Survey based questionnaire, regression analysis.	198 Canadian HTSMEs	The HTSMEs' governance structure is influenced by its business scope, strategic assets and industry dynamism.
Shrader (2001)	Exploration of factors moderating the relationship between collaboration activities of INVs and their performance in foreign markets.	Mixed-method approach, interview based questionnaire, secondary archival data, regression analysis	70 US high-tech INVs	Important moderators between INV collaboration and performance abroad are the R&D intensity and advertising intensity

3.4.3.2 Stage approaches

Stage approaches build on the behavioural theories of the firm (Cyert and March, 1963) and fall therefore under the behavioural school of the stage models in Coviello and McAuleys's (1999) approach to internationalisation. Stage approaches can be distinguished into the two main categories, the Uppsala process model (Johanson and Wiedersheim-Paul, 1975; Johanson and Vahlne, 1977, 1990) and the innovation related internationalisation models (Bilkey and Tesar, 1977; Cavusgil, 1980; Reid, 1981).

The Uppsala process model holds that firm internationalisation is a chain of establishment, an on-going process of experiential learning and increasing market commitment (Johanson and Vahlne, 2009). It suggests that firms gradually increase their foreign commitment due to increased experience and foreign market knowledge (Whitelock, 2002). The original Uppsala model implied that geographical proximity and close psychic and institutional distance are the key factors for foreign market entry (Ruzzier et al, 2006). However, in response to the changing international business environment and theoretical advances in IB research, Johanson and Vahlne (2009) refined their original model. In their new approach, they suggest that "now the business environment is viewed as a web of relationships, a network, rather than as a neoclassical market with many independent suppliers and customers." Therefore, the authors claim that outsidership of this network is the root of uncertainty for today's businesses while the old model defined psychic distance as the major source of uncertainty.

In contrast to the Uppsala model, the innovation-related internationalisation models explain internationalisation from a learning sequence of the firm in relation to the adoption of innovations (Bilkey and Tesar, 1977; Cavusgil, 1980; Reid, 1981). The focus is predominantly on the export development of SMEs (Andersen, 1993; Fletcher, 2001; Ruzzier, 2006). Innovation related models argue that SMEs consolidate and generate within a certain period an adequate resource base in response to a changing environment. This enables the firms to proceed to the next internationalisation stage² (Morgan and Katsikeas, 1997; Ruzzier et al, 2006).

Relevance of stage approaches in HTSME internationalisation research

In current empirical HTSME internationalisation research, only four studies have specifically adopted a stage approach (see Table 3.3). Interestingly, three of these studies have critically challenged the theoretical validity of stage approaches in the HTSME internationalisation context rather than taking their conceptual underpinning as a starting point for academic inquiry (see column ‘main findings’). This evokes essential implications regarding the suitability of stage models in contemporary HTSME research. For example, Levie and Lichtenstein (2010) reviewed stage models entrepreneurship and found that they are too deterministic in nature as they leave very limited strategic choices to the firm. The authors suggest to integrate the concept of opportunity into the models to create a more dynamic approach. This critical conception is in line with Seifert (2010:18) who argues “stage theories do not adequately address the fact that internationalization is a meaningful action and therefore implies choice, interpretation and collective social interaction.”

Furthermore, stage models hold that geographical proximity and reduced psychic distance are significant factors for the internationalisation of SMEs. However, in the context of high-

² For a detailed summary of export behaviour as an adoption of the innovation process see Exhibit 1 in Reid (1981, p.103).

tech industries, scholars have currently outlined the decreased importance of these factors for SME internationalisation. According to Wu and Lin (2010:1306), the reason is that “high-tech industries appear to be non-culture-bound industries, which involve in standardized operations and procedures across countries.” Hence, it appears that the accelerated entrance into global lead markets is of higher importance for an effective internationalisation of HTSMEs (Freeman et al, 2010; Haeusler et al, 2012). This claim is supported by the implication of the international entrepreneurship approach, which has gained much higher attention in current HTSME internationalisation research than the stage approaches (as the 27 empirical IE studies summarised in Table 3.1 proof). Nevertheless, Johanson and Vahlne (2009) suggest that the theoretical implications of the two approaches do not contradict. They claim that the BG/INV phenomenon is consistent with the stage theory as these firms are actually ‘born regionals’. The reasoning behind this claim is that their “international activities do not really span the globe in any significant fashion” (Johanson and Vahlne, 2009:1420). Instead, BGs and INVs usually internationalise in regional and culturally related markets.

In summary, the findings of the critical review of relevant studies suggest that stage models might not be able to account for the specific internationalisation patterns faced by SMEs in the high-tech sector³. Moreover, stage models seek to explain the firm’s process of internationalisation. However, the specific focus of this study is on firms, which already have internationalised. The research objectives address the FDI of HTSMEs with respect to the firms’ underlying ownership advantages and location decision. Therefore, other theoretical approaches might be more suitable to address the underlying research problem. For example, the network theory, which will be discussed in the following section.

³ For a detailed summary of these patterns, refer back to the sections concerning ‘High-tech SMEs’ and ‘High-tech Industries’ in chapter 2.

Table 3.3 Empirical HTSME studies adopting stage approaches

Author / Year	Research subject	Method	Sample	Main findings
Bell (1995)	Initial export decision and internationalisation of software SMEs.	Mixed-method approach, survey based questionnaire, semi-structured interviews, descriptive statistics, content analysis	88 Finish, Irish, Norwegian software SMEs	Stage models are insufficient to explain internationalization patterns of software SMEs as they do not properly reflect the underlying internationalization factors such as client followship, entering niche markets, and industry specific considerations.
Moen et al (2004)	Market entry forms and market selection of internationalising HTSMEs.	Case study approach, open-ended questionnaire, content analysis	5 Norwegian software SMEs	There is a limited correlation between the SMEs' experience in international markets and their choice of foreign market entry mode and market selection
Ojala (2008)	The firm's entry mode choice in a psychic distant market.	Case study approach, semi-structured open-ended interviews, content analysis	8 Finish software SMEs	Regarding the psychic distance of a foreign market, the manager's personal experiences and feelings towards the foreign country are more crucial than the actual cultural differences of the two countries
Zou and Ghauri (2010)	Gradual and rapid internationalisation of Chinese high-tech INVs.	Case study approach, content analysis	3 Chinese high-tech INVs	Generally, the gradual internationalisation model remains valid. However, Chinese high-tech INVs internationalise much quicker than suggested by previous research. They take a different route than suggested by the born global approach

3.4.3.3 Network theory

The network theory (Johanson and Mattson, 1987, 1988) builds on social exchange and resource dependency theories and holds that SME internationalisation occurs from behavioural patterns of network members in non-hierarchical systems. In Coviello and McAuleys' (1999) approach to internationalisation it falls under the relationship school of the network perspective. The reviewed HTSME internationalisation studies outline that the construction of the HTSME's international network is an entrepreneurial process of establishing, developing, maintaining, and dissolving relationships in an institutional and social web (see Table 3.4). These relationships provide the HTSME access to important functions such as knowledge, finance, human capital, etc. These help to maintain and increase its competitive position in the international market place (see column 'main

findings'). In particular, several studies emphasise the importance for HTSMEs to gain access to international networks as they are not able to organise the large amount of different international knowledge domains essential to innovation (Rigby and Hayden, 2013; Zou and Ghauri, 2010). Therefore, HTSMEs engage in cross boarder collaborations and innovation networks to facilitate the creation and diffusion of innovation (Van Geenhuizen and Nijkamp, 2012; Criscuolo and Narula, 2007).

Relevance of the network theory in HTSME internationalisation research

The findings of the literature review show that 18 empirical HTSME internationalisation studies have particularly applied the network theory (Table 3.4). This reflects the high relevance of the theory in HTSME internationalisation research. Its strength lies in the explanation why HTSMEs locate in clusters or regional technology-oriented complexes around the globe. The firms seek to gain access to international knowledge sources in order to bundle competencies to keep up with international competitors in terms of innovation, information flow, market share and cost reduction (see column 'main findings'). The specific mechanisms in international networks additionally support the HTSME to overcome their resource deficiencies, which often hinder internationalisation (Gassmann and Keupp, 2007; Tolstoy and Agndal, 2010).

In summary, the reviewed studies have commonly emphasised the importance of the network theory in HTSME internationalisation research. No single study has specifically criticised the theoretical validity of network theory in the context of HTSMEs and internationalisation. Nevertheless, scholars have frequently raised the point that it is rather complementary to other theories as it lacks to account for all aspects of HTSME internationalisation. For example, Dunning (2003) claims that network relations often consist in strategic alliances, which are time limited and usually follow specific objectives. Therefore, Dunning suggests

that this kind of relationships is not able to explain the patterns of FDI. Nevertheless, the networks of HTSMEs can be seen as an ownership advantage of the firm, which leads to FDI. Therefore, network theory seems to be highly relevant for this study as it complements other significant theories (Gassmann and Keupp, 2007). In a similar vein, the resource-based approaches of the firm might contribute valuable insights. These have been adopted from the field of strategic management to IB research in order to study internationalisation in light of the firm's resource endowments and will be discussed further in the following sections.

Table 3.4 Empirical HTSME studies adopting the network perspective

Author / Year	Research subject	Method	Sample	Main findings
Al-Laham and Souitaris (2008)	Internationalisation of German biotech firms: The impact of inter-organisational factors on the likelihood of the formation of international research alliances.	Secondary archival data, event history analysis	853 German biotech INVs	International relationships can already be achieved by locating in a local cluster. The likelihood of a firm's formation of international research alliances increases when the firm engages in alliances with local partners or research institutes and by the establishment of a central position in the local R&D community/network.
Chen et al (2009)	Growth strategies in light of technological, financial, and networking capabilities	Interview based questionnaire survey, regression analysis	238 Chinese high-tech INVs	Partnership growth leads to greater product diversity.
Colombo et al (2009)	The impact of international R&D alliances on the performance of HTSMEs.	Secondary data, econometric analysis	256 Italian HTSMEs	HTSMEs gain most from international R&D alliances when they cooperate with industrial partners from different countries. These countries should be located closer to world knowledge sources.
Coviello (2006)	The evolution of international networks of high-tech INVs.	Case study approach, content analysis, event analysis	3 New Zealand high-tech INVs	The study developed seven propositions regarding INV network dynamics as a foundation for future research in this area.
Elfring and Hulsink (2003)	The effect of network ties and degree of innovation on entrepreneurial processes of HTSMEs.	Case study approach, interviews, content analysis	3 Dutch HTSMEs	A mix of strong and weak network ties has a positive effect on radical innovation.
Gilbert et al (2008)	The relationship between firm performance, knowledge spillovers and firm location in a cluster.	Secondary data, path analysis, regression analysis	127 US high-tech INVs	Location in a cluster increases absorption of local knowledge, growth and innovation performance. However, technological spillovers are not the contributing cause for higher performance.

Haeusler et al (2012)	Benefits and risks of strategic alliances for high-technology new firms.	Survey based questionnaire, regression analysis	689 UK and German HTSMEs	The success of an alliance is dependent on the firms' alliance experience and its financial situation.
Hyder and Abraha (2004)	Product and skills development in HTSMEs through strategic alliances.	Case study approach, semi-structured interviews, content analysis	4 Swedish HTSMEs	Long-term relationships, learning, and complementary resources have a positive impact on firm performance. The formation of alliances is significantly influenced by environmental issues.
Keeble et al (1998a)	The internationalisation of HTSMEs in light of networking and local embeddedness.	Survey based questionnaire, descriptive statistics	100 UK HTSMEs	Internationalised HTSMEs engage more in network relations. They show higher growth rates and engagement in R&D collaborations.
Keeble et al (1998b)	The nature and extent of regional collective learning processes of HTSMEs.	Secondary archival data, descriptive statistics	715 UK HTSMEs	Regional collective learning is moderated by spinoffs, local networking and recruitment. However, wider national and global technology network are additionally significant.
Kenny and Fahy (2011)	The relationship between network resources and international performance of HTSMEs.	Survey based questionnaire, structural equation modeling	154 Irish HTSMEs	There is a positive relation between HTSMEs' network human capital resources and international performance while network resources combinations, information sharing and international performance appeared insignificant.
Moen et al (2004)	The entry forms and market selection of internationalising HTSMEs.	Case study approach, open-ended questionnaire, content analysis	5 Norwegian software SMEs	Firms choose the type of foreign market entry upon the available options in terms of their network relationships.
Ojala (2009)	The effect of network relations on a firm's internationalisation into psychic distant markets.	Case study approach, semi-structured interviews, content analysis	8 Finish software SMEs	Strategic reasons influence internationalisation in psychic distant markets rather than network relations
Romijn and Albu (2002)	The relationship between network relations, geographical proximity and innovative performance of HTSMEs.	Case study approach, structured interviews, statistical correlation analysis	33 UK HTSMEs	The regional science base and interaction with partners support high innovative performance of the HTSMEs.
Rothaermel and Deeds (2004)	Organisational learning (exploitation / exploration) from a strategic alliance perspective of technology Ventures.	Secondary data, structural equation modeling	325 US biotech SMEs	The integrated product development path of HTSMEs leads from exploration alliances, via products in development and exploitation alliances, to products on the market.
Styles and Genua (2008)	Effects of networks and entrepreneurial orientation on the internationalisation of firms originating from academic research.	Case study approach, interviews, observation, documentation, thematic analysis	4 Australian high-tech INVs	Academic network support internationalisation. Risk taking, technological innovativeness and autonomy support entrepreneurship. Proactiveness and product-market innovativeness support international success.
Tolstoy and Agndal (2010)	Foreign market entrance / expansion of the firm through the combination of	Case study approach, semi-structured	6 Swedish high-tech INVs	New international product ventures exploit a wide range of network resources. In contrast, new international market

	resources in firm networks.	interviews, thematic analysis		ventures rely on a more narrow range of network resources.
Van Geenhuizen and Nijkamp (2012)	The relationship between global knowledge networks, virtualisation, knowledge sourcing and local connectedness.	Case study approach, interviews, rough set analysis	21 Dutch HTSMEs	Firms use both local and global knowledge networks. Some multinational firms involved in global product creation lose local connectedness.

3.4.3.4 Resource-based view

The resource-based view (RBV) views the firm as a bundle of heterogeneous idiosyncratic resources and capabilities, which enable it to outperform competitors in a heterogeneous market, as long as the resources are valuable, rare, non-substitutable, costly-to-copy and sustainable over time (Barney, 1991; Peng, 2001; Wernefelt, 1984). IB researchers have commonly adopted resource-based approaches from the strategic management field in order to explain the interrelation of a firm's resource-base and its foreign market expansion (Bello and Kostova, 2012). In the context of HTSME internationalisation studies, the findings summarised in Table 3.5 highlight that the RBV is able to provide an integrated explanation of HTSME internationalisation. It approaches foreign market entry by considering the existing and future resource endowments of the HTSME (Tolstoy and Agndal, 2010). According to Wernefeld (1984), a firm's resource endowments can be classified in the categories physical, financial, and intangible resources. The latter, also known as tacit knowledge (Peng, 2001), has been determined as highly significant for HTSMEs in terms of sustained competitive advantage (Al-Laham et al, 2011; Melen and Nordman, 2009).

Relevance of the RBV in HTSME internationalisation research

Dimitratos et al (2009:144) suggest that the RBV "can provide valuable insights into how these small firms can overcome their resource constraints and effectively manage to prevail over complexities stemming from both organisational inefficiencies and environmental challenges abroad." The findings of the studies summarised in Table 3.5 corroborate this

claim as they acknowledge that internationalisation can leverage the HTSME's organisation of international resources. However, this process can cause high expenses for the firms, as resources are often location-bound and difficult to transfer (Rugman and Verbecke, 2009). Pertaining to the theoretical underpinning of the RBV in relation to HTSME internationalisation, several scholars argue that the RBV is too static (Majeed et al, 2011; Saarenketo et al, 2004) and tautological (Williamson, 1999) in nature as it tries to explain sustainable competitive advantage. Therefore, the RBV does not account for the heterogeneous structure of HTSMEs and the fast changing economic environment in the high-tech sector (Barreto, 2010). Furthermore, the RBV does not explain the causalities of HTSMEs' key resources and the performance of the firm (Fryges; 2009).

Table 3.5 outlines that five empirical HTSME studies have specifically applied the RBV to guide the empirical investigation. The reason for this relatively small amount is the availability of more refined resource-based approaches in the context of HTSMEs: The knowledge-based view and the dynamic capabilities perspective. These approaches are better able to account for the highly important knowledge related resources and capabilities of the HTSMEs. Therefore, the following paragraphs critically examine these approaches in the specific context of HTSME internationalisation.

Table 3.5 Empirical HTSME studies adopting RBV

Author / Year	Research subject	Method	Sample	Main findings
Almor and Hashai (2004)	Competitive advantages of small- and medium-sized multinationals.	Interview based semi-structured questionnaires, descriptive statistics	52 Israeli HTSMEs	The firms under investigation have internalised R&D and marketing activities while they have outsourced production activities
Chen et al (2009)	Complex strategic choices through which INV growth is pursued and attained.	Interview based questionnaire, regression analysis	238 Chinese high-tech INVs	Partnership growth results in higher product diversity and acquisition is more effective in realising firm internationalisation. Both support a higher chance of INV survival. Additionally, the authors elucidate the moderating effect of technological capability on the relationship between INV performance and growth strategies.

Hyder and Abraha (2004)	Product and skills development in HTSMEs through strategic alliances.	Case study approach, semi-structured interviews, content analysis	4 Swedish HTSMEs	Long-term relationships, learning, and complementary resources have a positive impact on firm performance. The formation of alliances is significantly influenced by environmental issues.
Tolstoy and Agndal (2010)	Foreign market entrance / expansion of the firm through the combination of resources in firm networks.	Case study approach, semi-structured interviews, thematic analysis	6 Swedish high-tech INVs	New international product ventures exploit a wide range of network resources. In contrast, new international market ventures rely on a more narrow range of network resources.
Zahra et al (2003)	Effects of tangible and intangible technological resources on speed and extend of sales internationalisation.	Survey based questionnaire, regression analysis	786 US high-tech INVs	Intangible technological resources are positively related to the speed and extend of sales internationalisation.

3.4.3.5 Knowledge-based view

The knowledge-based view (KBV) suggests that the competitive advantage of a firm is highly dependent on its ability to create and manage knowledge related resources (Grant, 1996; Kogut and Zander, 1992). The KBV has been commonly adopted in IB research after empirical findings revealed that knowledge-related determinants significantly influence the international expansion of firms (Knight and Cavusgil, 2004; Saarenketo et al, 2004). As this study is particularly interested in the HTSMEs' acquisition of foreign knowledge-assets via FDI, the KBV might provide a theoretical base to guide the investigation. The findings of the literature review of empirical HTSME studies adopting the KBV summarised in Table 3.6 support this claim. Results of these studies reveal that foreign knowledge-related assets significantly influence the dynamics of HTSME internationalisation (see e.g. Fernhaber et al, 2009; Filatotchev et al, 2009; Van Geenhuizen and Nijkamp, 2012). Leveraging these knowledge-assets can have a significant positive effect on firm growth and future competitiveness (Fernhaber et al, 2009).

In particular, this study is interested in two types of knowledge influencing the competitiveness of the HTSME: The technological knowledge (McEvily and Chakravarthy, 2002) and the international knowledge (Fernhaber et al, 2009). The technological knowledge

is significant in the underlying research context as it concerns the scientific processes related to the development and production of high-tech products. The international knowledge is relevant as it accounts for the “information, beliefs, and skills that organizations can apply to their internationalization activities” (Fernhaber et al, 2009:299). These two types of knowledge have been key subjects in previous empirical HTSME internationalisation studies (see column ‘research subject’ in Table 3.6). Therefore, the following section evaluates in detail the suitability of the KBV as an analytical tool for the underlying study.

Relevance of the KBV in HTSME internationalisation research

The summary in table 3.6 shows that the KBV has been particularly applied by 15 empirical HTSME studies and is therefore a commonly used approach in empirical HTSME internationalisation research. The reviewed studies report similar findings emphasising on the importance for HTSMEs to focus on the specialised knowledge gained from international network relations, the knowledge incorporated in the social capital of the firm and the foreign experience of the HTSME manager. In general, the findings of all studies are complementary rather than contradictory despite the fact that knowledge related aspects and HTSME internationalisation were approached from different angles (see column ‘research subjects’ in Table 3.6). This shows that the application of the KBV enables the researcher to investigate and relate different layers of international knowledge acquisition of HTSMEs. In essence, it appears that all reviewed studies generally agreed on the relevance of the KBV in a HTSME research context.

Only a few studies suggest a more holistic knowledge-based approach to study HTSME internationalisation as they believe that the KBV partly lacks to provide sufficient explanation for certain findings. For example, some studies recommend an inclusion of social capital theory and network theory to enhance the explanatory power of the KBV

(Gassmann and Keupp, 2007; Presutti et al, 2007; Rialp-Criado et al, 2010). Moreover, studies focusing to a lower extent on knowledge acquisition have highlighted the importance of knowledge related learning processes (DeJong and Freel, 2010; Saarenketo et al, 2004). These processes fall under the dynamic capabilities approach, which suitability in a HTSME research context will be discussed in the next section.

Table 3.6 Empirical HTSME studies adopting KBV

Author / Year	Research subject	Method	Sample	Main findings
D'Angelo (2012)	The relationship between innovation measures and export intensity.	Survey based questionnaire, regression analysis	689 Italian HTSMEs	R&D employees significantly influence the export intensity while R&D expenditure does not. Universities as R&D partners, product innovations and turnover derived from innovative activities positively influence the export intensity.
Fernhaber et al (2009)	INVs acquisition of internal and external new knowledge.	Survey based questionnaire, regression analysis	206 US high-tech INVs	International knowledge is sourced externally from alliance partners, venture capital firms, and firms in close proximity.
Filatotchev et al (2009)	Factors affecting the export orientation and export performance of HTSMEs in an emerging economy.	Survey based questionnaire, descriptive statistics	711 Chinese HTSMEs	Besides the development of capabilities through R&D and technology transfer, export orientation and performance depend on entrepreneurial characteristics (e.g. the founder's international background, global networks). The involvement of a returnee entrepreneur is positively related to export orientation and performance.
Fontes and Coombs (1997)	The development of NTBFs in less advanced countries and their role in the development and diffusion of technology.	Case-studies, semi-structured interviews, content analysis	26 Portuguese NTBFs	Firms in that context highly contribute to the acquisition, absorption and dissemination of new technology.
Ganotakis and Love (2011)	The relationship between R&D, product innovation, and exporting of NTBFs.	Survey based questionnaire, regression analysis	412 UK NTBFs	Export activities are positively related to internal R&D, lagged productivity and supply-chain cooperations.
Gassmann and Keupp (2007)	Generation and protection of the competitive advantage that enables early and rapid BG internationalisation.	Case study approach; interviews and secondary data; content analysis	6 Swiss, German and Australian biotech BGs	Firms use a variety of business models for internationalisation and are not confined to a single strategy of development and marketing a product.
Gilbert et al (2008)	The relationship between firm performance, knowledge spillovers	Secondary data, path analysis, regression analysis	127 US high-tech INVs	Location in a cluster increases absorption of local knowledge, growth and innovation performance. However, technological spillovers are not

	and firm location in a cluster.			the contributing cause for higher performance.
Jones and Crick (2004)	The usefulness, utilisation, and perceptions of overseas market information.	Mixed-method approach; survey based questionnaire and qualitative interviews, descriptive statistics, content analysis	24 UK HTSMEs	Social networks and internet sources are very useful to gather information. Information must cost a reasonable price. Different information from particular sources is required.
Liu et al (2010)	The impact of returnee entrepreneurs and the international experience of domestic entrepreneurs on the firm's innovation performance.	Survey based questionnaire, descriptive statistics	711 Chinese HTSMEs	Firms of returnee entrepreneurs are more innovative than local competitors. The returnee firms constitute as a spillover channel on non-returnee firms by enhancing their innovation performance.
Love and Ganotakis (2013)	The effects of exporting on the innovation performance of HTSMEs.	Survey based questionnaire, regression analysis	412 UK HTSMEs	Export supports the firms innovation activities but does not increase the intensity of innovation.
Prashantham and McNaughton (2006)	Social capital from MNE subsidiaries as a facilitator of SME internationalisation.	Case study approach; interviews and secondary data; content analysis	1 Scottish technology and collaboration initiative	The formation of social capital through technology collaborations contributes to knowledge outcomes and therefore increases the likelihood of SME internationalisation.
Saarenketo et al (2004)	Dynamic knowledge related learning processes in internationalising high-tech SMEs.	Longitudinal survey based questionnaire; descriptive statistics, general linear model	Finish HTSMEs 1 st round: 71 2 nd round: 49	Several knowledge-related determinants significantly affect the dynamic internationalisation process.
Van Geenhuizen and Nijkamp (2012)	The relationship between global knowledge networks, virtualisation, knowledge sourcing and local connectedness.	Case study approach, interviews, rough set analysis	21 Dutch HTSMEs	Firms use both local and global knowledge networks. Some multinational firms involved in global product creation lose local connectedness.
Yli-Renko et al (2002)	The impact of a HTSME's intra- and inter-organisational relationships on the foundation of its distinctive knowledge base and international growth.	Mixed-method approach, interviews, survey based questionnaire, structural equation modeling	77 Finish HTSMEs	Strong internal and external social capital ties have a strong positive impact on the HTSME's knowledge base and international growth.
Zahra et al (2000)	Effects of international expansion on technological learning and financial performance.	Survey based questionnaire, regression analysis, secondary data analysis	321 US high-tech INVs	There is a strong relationship between International diversity and entry mode, breadth, depth and INV's speed of learning.

3.4.3.6 Dynamic capabilities perspective

Dynamic capabilities are defined as “the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” (Teece et al, 1997:516). Therefore, the dynamic capability perspective seems to be suitable to explain why and how specific HTSMEs possess a competitive advantage in a rapidly changing and unpredictable business environment. The findings of the literature review summarised in Table 3.7 confirm this claim by highlighting the increasing significance of the HTSMEs’ dynamic capabilities in the internationalisation process. Building on the Schumpeterian (1934) view, Wiggins and Ruefli (2005) emphasise that the time span for which HTSMEs hold a competitive advantage is constantly decreasing. In the fast changing high-tech sector, this phenomenon is amplified, as the rate of technological change is rapid (Li et al, 2013) and markets are volatile due to constant reconfiguration of firms and other market players (DeJong and Freel, 2010). Therefore, Barreto (2010) claims that HTSMEs need to focus on steady adaptation, integration, and reconfiguration of internal and external competences and resources in order to achieve and maintain a competitive advantage.

Relevance of the dynamic capabilities perspective in HTSME internationalisation research

Most empirical HTSME studies adopting a dynamic capabilities perspective investigated the dynamic learning processes and knowledge management of internationalising HTSMEs (see ‘research subject’ column in Table 3.7). The reviewed studies have not specifically aimed to explore the HTSME’s internationalisation on the basis of its dynamic capabilities. This implies that the theoretical underpinnings of the dynamic capabilities perspective are too narrow and specific to explain the international expansion of HTSMEs, e.g. through the mode of FDI. Nevertheless, the main findings summarised in Table 3.7 outline that the dynamic capabilities perspective contributes valuable insights to the understanding of HTSMEs’ knowledge related internationalisation patterns. For example, the absorptive capacity (DeJong and Freel, 2010) and technological learning abilities (Carayannis et al,

2006) present a precise explanation for patterns of international knowledge creation. Furthermore, Andersson et al (2004) suggest that the dynamic capabilities perspective can explain the firms' acquisition of specific knowledge in global markets. It relates to their diversification strategy from their larger competitors. In line with this argument, Sawers et al (2008) show that the dynamic capabilities approach can be adopted to investigate the formal and informal protection mechanisms of HTSMEs within collaborations with larger MNEs. In summary, the findings outlined in Table 3.7 suggest that the dynamic capabilities perspective provides significant explanations to certain knowledge related internationalisation patterns of HTSMEs. However, on its own it is too limited to account for all relevant aspects around internationalised HTSMEs, particularly in light of FDI activities. The following section discusses the combined relevance of the reviewed theories in the previous sections.

Table 3.7 Empirical HTSME studies adopting the dynamic capabilities perspective

Author / Year	Research subject	Method	Sample	Main findings
Alegre et al (2011)	The effect of knowledge management on the innovation performance of HTSMEs.	Survey based questionnaire, structural equation modelling	132 French biotech SMEs	Knowledge management has a positive impact on innovation performance and therefore sustained competitive advantage.
Carayannis et al (2006)	The impact of technological learning and ICT technology on the entrepreneurial development in different (knowledge) economies.	Case study approach, secondary data analysis	9 international initiatives to foster knowledge intensive entrepreneurial firms	The study derives a set of valuable lessons for policy makers, practitioners and entrepreneurs.
DeJong and Freel (2010)	The role of absorptive capacity and the reach of collaboration in HTSMEs.	Survey based questionnaire, descriptive statistics	316 Dutch HTSMEs	HTSMEs usually collaborate with local partners. Collaboration with more distant partners is positively related to greater R&D expenditure.
Filatotchev et al (2011)	The impact of knowledge spillovers from returnee entrepreneurs.	Secondary data, regression analysis	1318 Chinese HTSMEs	Spillovers of returnee entrepreneurs have a positive impact on the innovation activities of other local firms. This is moderated through the absorptive capacity and employee skills of the other firms.

Saarenketo et al (2004)	Dynamic knowledge related learning processes in internationalising HTSMEs.	Longitudinal survey based questionnaire; descriptive statistics, general linear model	Finish HTSMEs 1 st round: 71 2 nd round: 49	Knowledge-related determinants have a significant effect on the dynamics of internationalisation
Sawers et al (2008)	The protection of HTSME's dynamic capabilities in collaborations with large MNEs.	Interview based questionnaire survey, regression analysis	43 South African HTSMEs	Formal and informal protection mechanisms can minimise unintentional knowledge flows from the HTSME to its larger partner.
Zahra et al (2000)	Effects of international expansion on technological learning and financial performance.	Survey based questionnaire, regression analysis, secondary data analysis	321 US high-tech INVs	There is a strong relationship between international diversity and entry mode, breadth, depth and INV's speed of learning.

3.4.4 Summary of the reviewed theories and frameworks

Table 3.8 summarises to what extent the theories and frameworks discussed in the literature review were particularly announced in empirical HTSME internationalisation studies as the conceptual base for the empirical investigation. The international entrepreneurship perspective has been the most commonly applied (27 studies). The reason is that young HTSMEs conform the BG and INV profile better than firms in other industries (e.g. manufacturing). The ratio of internationalised HTSMEs is higher and they pursue more often an accelerated internationalisation process than young firms in other industries (as extensively discussed in the context chapter). Therefore, IE researchers usually develop their samples around young firms in high-tech industries while other SME researchers often use mixed samples or manufacturing or service SMEs. Another reason might be that IE is a comparatively new field, which has been characterised as fragmented and lacking common theoretical integration (Keupp and Gassmann, 2009). Therefore, the field has provided a comparatively high amount of unsolved research questions, which have caught the attention of many HTSME researchers in the last two decades. However, in general, the IE approach is not suitable in this study for two reasons. First, the unit of analysis is the whole HTSME population in the nanotech and biotech industries, and not young HTSMEs that comply with the specific IE definitions. Second, the IE perspective is able to explain accelerated

international expansion of SMEs. However, it lacks to explain the existing FDI of SMEs, which is the key subject in this study.

In contrast, the internalisation theory is of high relevance for the underlying study as it explains FDI and the existence of MNEs. However, the theory has only been six times specifically considered in empirical HTSME internationalisation studies. This might be related to the low acknowledgement of FDI in the HTSME internationalisation context in the last decades. Nevertheless, current studies showed that it is an upcoming research topic (De Maeseneire and Claeys, 2012; Li et al, 2011; Li et al, 2013; Zapkau et al, 2013). Therefore, internalisation theory is considered as relevant for this study.

Stage approaches have only been adopted in four empirical HTSME internationalisation studies. Most scholars concluded that stage models are outdated and that newer models such as e.g. the IE approaches better grasp the internationalisation patterns of HTSMEs. Thus, stage approaches will not be considered any further in the following sections leading towards the conceptual framework of this study. In contrast, resource-based approaches appear to be highly relevant pertaining to the underlying research problem. In the high-tech context. Particularly the KBV has gained high prominence (15 studies) as it is specifically suitable to empirically investigate firms in high-tech industries. In combination with the relevant dynamic capabilities perspective (seven studies) it is superior to the traditional RBV (five studies). Thus, the implications derived from the KBV and dynamic capabilities perspective will be taken forward to the theoretical framework chapter as they provide significant underpinnings for the upcoming empirical investigation.

Finally, the network theory has been adopted in eighteen empirical HTSME studies. All reviewed studies confirmed its explanatory power regarding interorganisational and interpersonal relationships of HTSMEs and patterns of internationalisation. Hence, the network theory contributes key implications to the conceptualisation of the underlying

research problem. Thus, it will be a key component within the conceptual framework of this study. In summary, the literature review revealed that relevant theoretical approaches to the underlying research context stem from internalisation theory, KBV, dynamic capabilities perspective and network theory. Hence, it appears that a unifying framework of these approaches seems to be the most suitable to address the research problem of this study. Therefore, the following section introduces Dunning's (2000) unifying eclectic envelope paradigm to critically discuss if it can serve as an analytical framework for understanding the FDI of HTSMEs.

Table 3.8 Summary of theoretical approaches in HTSME research

Theory / Framework	Count of empirical HTSME studies
International entrepreneurship	27
Internalisation theory	6
Stage theory	4
Resource-based view	5
Knowledge-based view	15
Dynamic capabilities perspective	7
Network theory	18

3.4.5 Eclectic envelope paradigm

3.4.5.1 Introduction

The eclectic envelope paradigm is the last framework to be discussed in this literature review. The reason for its discussion at the very end of the literature review is that it integrates key aspects of the theories/frameworks summarised in Table 3.8 in one framework. Its conceptual foundation is based on the eclectic paradigm (Dunning, 1977; 1988), which is an analytical framework to explain the rational for FDI. Hence, it falls under the economic school of FDI theory in Coviello and McAuley's (1999) approach to internationalisation. It builds on the interaction of three sets of interdependent variables, ownership (O) advantages, location (L) advantages, and internalisation (I) advantages. Thus,

it is also known as the OLI paradigm. It is based on Hymer's (1960, 1976) argument of FDI and holds that a firm's specific home-based competitive advantage justifies asset-exploiting FDI, as it helps to overcome the costs of establishing the business abroad. Accordingly, a set of three conditions has to be existent to justify the FDI. First, the investing firm has to possess an ownership advantage over indigenous firms in the foreign market (O-advantage). Second, the investing firm uses factor inputs from the host country to enhance profitability (L-advantage). Third, the exploitation of firm-specific ownership advantage in the host country through the entry mode of FDI must be more beneficial than exploitation through other modes such as selling or leasing (I-advantage) (Buckley and Casson, 1976; Rugman, 2010).

The focus of the underlying study is particularly on the O and L-advantages. These serve as a starting point for the empirical investigation for several reasons. The I-advantages are seen as determinant factors for the HTSME's choice of FDI as a foreign entry mode (Dunning and Lundan, 2008). However, the HTSMEs in the sample of this study have already entered a foreign market through the mode of FDI. Therefore, it is taken for granted that the firms possess the required I-advantages to engage in FDI. As Narula (2012:192) outlines, "The I-advantage is essentially the *raison d'être* of the MNE. The decision to internalize is a precondition for the interaction of O and L advantages, and the degree to which an MNE is able to substitute one class of O assets for another is also shaped by it." Therefore, this study does not consider the internalisation sub-paradigm *per se*. This approach is consistent with previous empirical studies that adopted the eclectic envelope paradigm framework and shifted the research focus on the O and L-advantages, due to a specific research setting and research problem (see Arvanitis and Hollenstein, 2011; Brouthers et al, 1996; Hollenstein, 2005; Majeed et al, 2011; Pinho, 2007).

3.4.5.2 The FDI motivations in the eclectic envelope paradigm

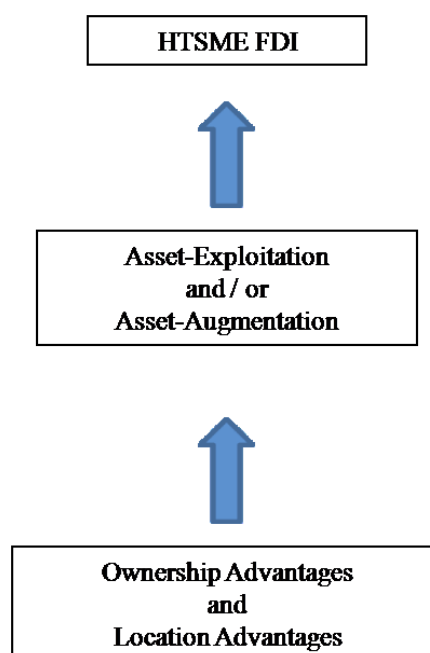
The traditional eclectic paradigm differs between three types of FDI (Dunning, 1988). Market seeking FDI, which is designed to trade in one or several foreign markets. Resource seeking FDI, which is designed to access natural resources and unskilled labour. Efficiency seeking FDI, which is designed to organise the division labour more efficiently or to specialise an existing portfolio of assets in the home and host country. The latter type of FDI usually occurs time delayed building on the previous types of FDI. This traditional eclectic paradigm focuses on MNEs' FDI to exploit home-based O-advantages in combination with foreign factor inputs. Accordingly, it is a framework to explain FDI from the perspective of large and well-established production MNEs. In this research setting, the eclectic paradigm has proven to be one of the most influential frameworks over the last decades (Buckley and Hashai, 2009; Cook et al, 2011; Verbeke and Yuan, 2010). Nevertheless, it has also been criticised by scholars who claimed that the eclectic paradigm suffers from its conceptual ambiguity (Rugman, 2010). The critics argue that the paradigm is a broad synthesis of models rather than a framework in itself, and therefore, it is too rich to be formalised (Narula, 2010; Eden and Dai, 2010). However, the paradigm has also developed over the years in order to overcome its limitations and to adjust to the dynamics of the changing business environment. Its most updated version is the envelope paradigm (Dunning, 2000; 2003; 2004; Dunning and Lundan, 2008). The strength of the envelope paradigm lies in explaining FDI within a dynamic and increasingly knowledge intensive business environment.

Thus, the envelope paradigm extends the basic structure of the eclectic paradigm by incorporating strategic knowledge aspects of internationalisation. In particular, besides the efficiency, market and resource seeking FDI motivations of the firm, it additionally incorporates the strategic asset seeking motivation in order to account for the firm's increasingly important quest for knowledge related assets (Dunning, 2000). Therefore, the envelope paradigm framework reaches beyond the traditional asset-exploiting patterns of

FDI (Buckley and Hashai, 2009; Ellram et al, 2013). As Arvanitis and Hollenstein (2007:68) elaborate, “This extension, which explicitly accounts for firm strategies designed for acquiring foreign knowledge and technology, qualifies the OLI paradigm as a comprehensive approach for explaining the internationalisation of manufacturing, R&D and other business functions.” Hence, the updated envelope paradigm has become an analytical IB framework, which draws the attention of the researcher to a synthesis of relevant theoretical approaches in the current business environment (Wrona and Trapczynski, 2012). It has overcome its original simplicity by accounting for modern business phenomena such as alliance capitalism, network relations and knowledge-related aspects (Arvanitis and Hollenstein, 2011; Dunning, 2003; Narula, 2010). The findings of the first part of the literature review showed that these aspects are highly relevant for the FDI of HTSMEs

The strategic asset seeking FDI motivation is organised under the new asset-augmenting perspective in the envelope paradigm. In combination with the traditional asset-exploiting perspective (which organises market seeking, resource seeking and efficiency seeking FDI), the envelope paradigm framework is able to account for the underlying motivations of HTSMEs to undertake FDI. More specifically, the asset-exploiting and asset-augmenting perspectives act as mediators between the O and L-advantages related to the FDI of HTSMEs (see Figure 3.2). The following section provides the definition and discussion of the asset-exploitation and asset-augmentation perspectives within the envelope paradigm framework in this study.

Figure 3.2 The asset-exploiting/augmenting function as mediator between O and L advantages and FDI



Source: Developed by the author

3.4.5.3 The asset-exploiting FDI perspective in the envelope paradigm

The asset-exploiting FDI perspective “views FDI as the transfer or exploitation of firm-specific advantage and assumes that firms should possess certain forms of rent-yielding resources when investing in a host country (Makino et al, 2002:404). Its theoretical foundations are based on Vernon (1966) who implies that competitive advantage is gained through the exploitation of firm specific technology. The focus of asset-exploiting FDI is on the static O-advantages, which are “such advantages as the income generating resources and capabilities possessed by a firm, at a given moment of time” (Dunning, 2000:169). In order to exploit these O-advantages, the firm undertakes FDI in a foreign location where it can take advantage of its existing technology (market seeking FDI) due to complementary inputs located in this host location (efficiency seeking FDI) (Rugman, 2010). Within the envelope paradigm framework adopted in this study, the market seeking and efficiency seeking FDI reasons constitute the asset-exploiting FDI perspective. The asset-exploitation through resource seeking FDI is of lower significance in this study as access to natural resources (e.g.

minerals, agricultural products, unskilled labour, etc) can be neglected in the context of high-tech industries and SMEs (Chidlow et al, 2009). It is rather common for HTSMEs to possess a technological advantage or the ability to organise operations more efficiently than indigenous firms (Parrilli, 2008). This exclusion of the resource seeking perspective follows the conceptualisation of Granstrand et al (1993) who focus only on the other two perspectives in the knowledge context.

The market and efficiency seeking reasons for internationalisation are specifically significant in the high-tech sector as it has a highly internationalised market structure with global customers and suppliers (De Maeseneire and Claeys, 2012; Zeng et al, 2010). Therefore, the asset-exploiting FDI perspective in the envelope paradigm enables the researcher to investigate traditional motives for FDI related to the exploitation of firm-specific advantages (Rugman, 2010). Besides the asset-exploiting perspective, the asset-augmenting perspective complements the explanation of FDI. Asset-augmenting FDI is related to the upgrading of firm-specific advantages abroad. It has to be noted that is important that asset-exploiting and asset-augmenting FDI activities should always be jointly investigated as Narula and Santangelo (2012:22) highlight that both activities “are rarely done exclusively, and this is increasingly so.” The following section defines asset-augmenting FDI.

3.4.5.4 The asset-augmenting FDI perspective in the envelope paradigm

Asset-augmenting FDI is defined as foreign investment to access and acquire strategic assets (such as technological, marketing, and management skills) in order to enhance existing firm-specific assets or to create new firm-specific assets (Dunning, 2000; Kuemmerle, 1999a; Rugman, 2010). The notion of FDI related to asset-augmenting activities is empirically captured in early contributions on international R&D units (Cordell, 1973; De Mayer and Mizushima, 1989; Pearce, 1989; Ronstadt, 1978) and has later been influenced by the

‘exploration and exploitation’ perspective in organisational learning introduced by March (1991). He claims that foreign exploration relates to the access and integration of new knowledge to increase future returns, while exploitation entails the use of existing knowledge to increase present returns (March, 1991). Subsequently, IB scholars have started to scrutinise the phenomenon of foreign asset-exploration in an increasingly globalised economy resulting in a number of seminal contributions to the literature (see Almeida and Phene, 2004; Cantwell and Piscitello, 2005; Chiesa, 1996; Dunning, 2000; Florida, 1997; Frost, 2001; Hakanson and Nobel, 1993; Kuemmerle, 1999a, 1999b; Le Bas and Sierra, 2002; Makino et al, 2002; Phene and Almeida, 2008; VonZedtwitz and Gassmann, 2002).

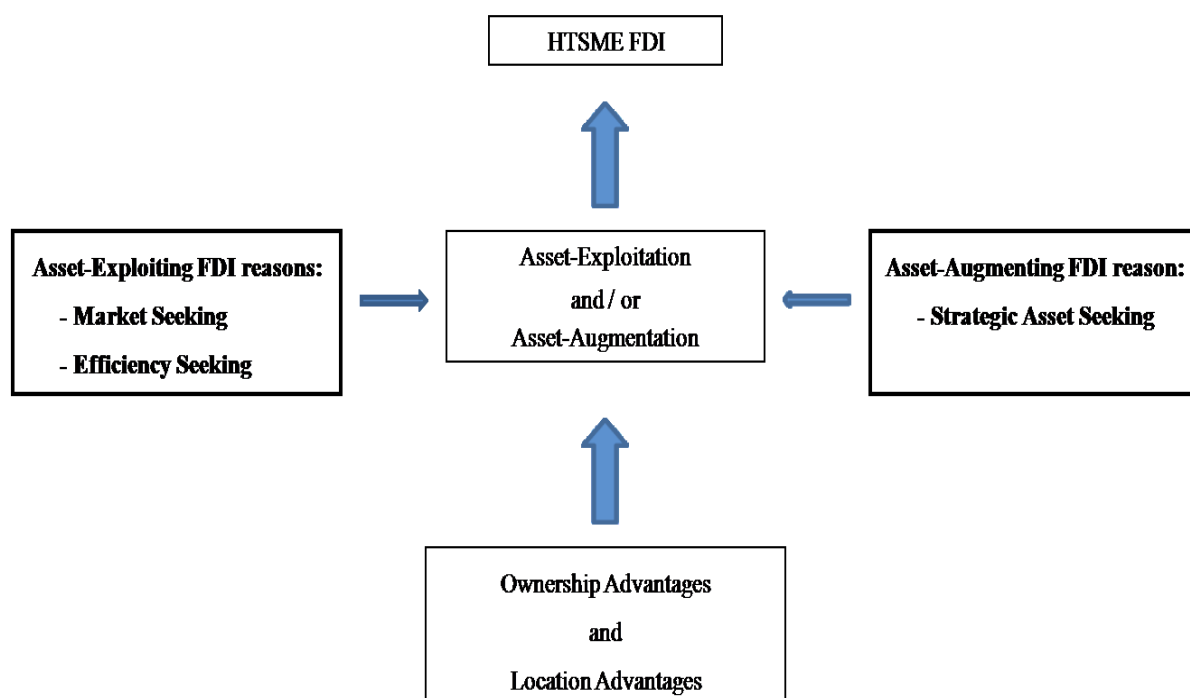
For example, Kuemmerle’s (1999a) typology delineates two different missions of foreign R&D sites, the ‘home-base-augmentation’ and the ‘home-base-exploitation’. The latter type contains the shift of existing home-based knowledge and capabilities to the foreign entity in order to adapt existing products, manufacturing and marketing techniques to the local market. In contrast, the home-based-augmentation is conducted to access and integrate unknown superior knowledge in order to transfer it back to the firm’s home country. Nobel and Birkinshaw (1998) have followed in their study of foreign R&D subsidiaries a similar approach to Kuemmerle (1999a). They distinguish subsidiary roles between ‘international adaptor’ and ‘international creator’. The international creator has basically the same task as Kuemmerle’s home-base-augmenting subsidiary. The role of the international adaptor subsidiary is more related to Kuemmerle’s home-base-exploiting subsidiary. It rather supports local R&D in the form of facilitating technology and marketing transfer from the home country in order to adapt it to the host country environment. Ito and Wakasugi (2007) differentiate between support-oriented R&D and knowledge sourcing R&D. While the labels of these R&D functions differ to Kuemmerle’s and Nobel and Birkinshaws’ approaches, the actual activity conducted in the functions is equal to the other two approaches. In summary, it appears that the asset-exploring FDI is highly significant for firms operating in high-tech

industries as it allows to gain access to fundamental knowledge-assets abroad (Iwasa and Odagiri, 2004; Parrilli, 2008).

Dunning (2000) labels this asset-exploring FDI as strategic asset seeking FDI in the envelope paradigm. He suggests, strategic asset seeking FDI is strongly connected to the firm's possession of dynamic O-advantages, which are "the ability of a firm, to sustain and increase its income generating assets over time" (ibid:169). Thus, dynamic O-advantages enable the firm to find and acquire technological knowledge and capabilities abroad. Previous HTSME internationalisation studies have emphasised the high significance of dynamic O-advantages for internationally active HTSMEs (Alegre et al, 2011; DeJong and Freel, 2010; Filatotchev et al, 2011; Liu et al, 2010). They facilitate the integration of new knowledge-assets that are supposed to enhance the HTSME's existing O-advantages (Aharoni and Ramamurti, 2011).

Eden and Dai (2010:24) summarised the increasing importance of dynamic O-advantages as a shift "from a focus on exploiting O-advantages to managing O-assets." Current empirical findings support this claim by emphasising the importance of strategic asset seeking FDI and dynamic O-advantages. For example, Colakoglu et al (2014) found that FDI from high-tech firms into the US is instigated to draw upon local knowledge. Thus, FDI is used as a knowledge channel to access and integrate superior skills and knowledge (Branstetter, 2006; Criscuolo, 2009; Mudambi, 2008). This is in line with findings of Galan et al (2007) who outline that firms base the decision to undertake FDI on the availability of technological and infrastructure factors rather than on traditional cost factors. Therefore, it appears that asset-augmenting FDI increasingly gains significance in the context of HTSMEs and FDI. Figure 3.3 summarises the previous sections and outlines how the asset-augmenting and asset-exploiting FDI perspectives contribute to develop a framework to investigate the different types of FDI of HTSME under consideration of specific sets of O and L-advantages.

Figure 3.3 Asset exploitation and augmentation within the envelope paradigm framework



Source: Developed by the author

3.4.5.5 The eclectic envelope paradigm in the empirical SME and high-tech context

Extant literature provides very little information on the paradigm's applicability in the specific context of SMEs and knowledge seeking FDI. Table 3.9 summarises that only six studies have specifically adopted the paradigm in an empirical study of SME internationalisation. Only two of these six studies have solely focused on SMEs in high-tech industries (see Almor and Hashai, 2002; Brouthers et al, 1996). Nevertheless, all six studies commonly acknowledged that the framework is a useful tool to predict the foreign entry mode choice of SMEs in the light of firm-specific O-advantages and location specific L-advantages (see column 'main findings'). Abidi et al (2011) support these findings in a theoretical paper. The authors adopted the envelope paradigm to discussing how HTSMEs grow in the international marketplace. They suggest that HTSMEs engage first in asset-exploiting activities abroad in order to cover the costs of the FDI and subsequently increase their asset-augmenting activities in case the host location offers valuable knowledge sources.

However, Abidi et al (2011) were not able to test their theoretical propositions as they did not obtain and analyse empirical data. Therefore, this study seeks to advance existing knowledge by testing the envelope paradigm framework in an empirical study of the asset-exploiting and asset-augmenting FDI of HTSMEs. This research aim is in line with other scholars who claimed that the paradigm needs to be exposed to rigours of empirical testing to assess its applicability in different contexts (Brouthers et al, 1999). Buckley and Hashai (2009) have followed this request in a theoretical paper. They formalised internationalisation in the eclectic paradigm in order to provide a starting point for further empirical testing. Complementary to Buckley and Hashais' effort, this study can provide specific implications regarding the question if the envelope paradigm can serve as an analytical framework for understanding the different types of FDI of HTSME.

Table 3.9 Empirical SME studies adopting the envelope paradigm

Author / Year	Research subject	Method	Sample	Main findings
Almor and Hashai (2002)	A theoretical framework derived from the eclectic paradigm to explain international configuration of HTSMEs.	Interview based questionnaire, Cochran-Mantel-Heanszel statistics	56 Israeli HTSMEs	The eclectic paradigm can be employed in a HTSME study, however, it requires modifications to account for the different nature of HTSMEs
Brouthers et al (1996)	Foreign entry mode selection activities of HTSMEs.	Survey based questionnaire, descriptive statistics, analysis of variance	125 US software SMEs	The selection of entry mode is more integrated for firms with greater ownership advantages and greater locational advantages in the target market.
Hollenstein (2005)	Factors determining the choice of a specific internationalisation strategy.	Survey based questionnaire, econometric analysis	2.424 Swiss SMEs, mixed industries	O-advantages are the main drivers of internationalisation, irrespective of firm size and internationalisation strategy.
Majeed et al (2011)	The impact of ownership, location and cognitive dimensions on SME entry mode choice.	Survey based questionnaire, regression analysis	171 Pakistani SMEs	High value generation entry modes are determined by ownership, location and cognitive advantages.
O'Gorman and McTiernan (2000)	The usefulness of the eclectic paradigm in explaining pattern and extent of internationalisation by SMEs.	Survey based questionnaire, descriptive statistics	16 Irish SME hotel groups	Internationally successful SMEs must develop both an ownership advantage that transfers to international markets, and the organisational capacity necessary to support an internationalisation strategy.
Pinho (2007)	Drivers and inhibitors of SME's foreign entry mode decision.	Survey based questionnaire, regression analysis	87 Portuguese SMEs	The mode of entry is determined by the SME's international experience, innovative ability, market specific knowledge and growth

				potential. SMEs conduct low cost activities to minimize associated risks abroad.
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3.4.5.6 Summary of the eclectic envelope paradigm

The sections above have introduced and discussed the development of the static eclectic paradigm related to the foreign production of MNEs into the more dynamic envelope paradigm applicable in various research fields. It was highlighted that this study focuses on the ownership and location perspectives of the paradigm, as the firms under investigation in this study have already internalised foreign assets. The discussion of the different FDI motivations in the paradigm led to the determination of the relevant efficiency seeking and market seeking motivations within the asset-exploiting FDI perspective. For the asset-augmenting perspective, the strategic asset seeking motivation was identified as highly relevant for the underlying research context. The reasoning was derived from related literature in the field. Furthermore, a systematic analysis of empirical SME studies, which have adopted the eclectic envelope paradigm, enriched the argumentation and provided a comprehensive starting point for the conceptual development in this study.

3.5 Synthesis of the literature review and justification of the gap

The findings of the literature review on the internationalisation of HTSMEs show that scholars have not reached an agreement on which theoretical framework is the most adequate to explain cross-border activities of HTSMEs. Many studies concluded that the traditional theoretical SME internationalisation approaches are either not suitable anymore or do not grasp all relevant aspects of the international engagement of HTSMEs (Bell, 2004; Gassmann and Keupp, 2007; Melen and Nordman, 2009; Ojala and Tyrväinen, 2008; Presutti et al, 2007; Spence and Crick, 2006; Tolstoy and Agndal, 2010). Furthermore, the findings of the literature review revealed that empirical research has almost completely neglected the upcoming phenomenon of the FDI activities of HTSMEs. Only a few authors

provide an empirical investigation of the topic (e.g. Li et al, 2011; Li et al, 2013; Zapkau et al, 2013). Accordingly, literature has not been able to determine a theory or framework that covers all relevant aspects to explain the FDI activities of HTSMEs (Dimitratos et al, 2014; Kuovalinen 2012; Majeed et al, 2011; Ruzzier et al, 2006). Therefore, this study sets out to fill this gap by testing the suitability of the envelope paradigm in this new context. This research aim is supported by several arguments developed from the literature review suggesting that the envelope paradigm might be a suitable tool to enhance the understanding of the FDI of HTSMEs.

First, the flexible nature of the envelope paradigm allows narrowing its parameters (O and L-advantages) down to distinct sets of advantages for firms operating under specific conditions in a defined environment (Cantwell and Narula, 2001). Hence, it is possible to configure a specific envelope paradigm framework that contains customised sets of O and L-advantages relevant to the different types of FDI of HTSMEs. Second, the updated envelope paradigm is applicable to a wider range of subjects as it incorporates not only the asset-exploiting FDI motivations but also the asset-augmenting FDI motivation (Eden and Dai, 2010). It explicitly concerns the firm's quest to acquire new or complementary knowledge and capabilities abroad (Narula and Santangelo, 2012). Hence, the application of the paradigm is not anymore limited to explain the large-scale foreign production of MNEs. It is additionally suitable to explain the organisation of supplementary assets to increase the future performance of the firm (Arvanitis and Hollenstein, 2011; Narula and Santangelo, 2012). This strategic asset seeking behaviour has been identified as highly significant for HTSMEs (Fernhaber et al, 2009; Van Geenhuizen and Nijkamp, 2012; Haeusler et al, 2012; Li et al, 2011).

Third, in response to the increasing significance of dynamic location factors as sources of learning and innovative capabilities (Meyer et al, 2011), the updated location parameter

embraces the criteria of finding non-imitable location bound created knowledge assets (Dunning, 2000; Dunning and Lundan, 2008). Accordingly, the paradigm is now able to account for foreign location choice related to the firm's desire to augment host country knowledge assets (Narula and Santangelo, 2011). The location factors representing these knowledge assets have been identified as highly significant within the internationalisation process of HTSMEs (Haeusler et al, 2012; Liu et al, 2010). Fourth, as the literature review of this study showed, the theories embraced under the envelope paradigm have already been individually validated as relevant in empirical research on international activities of HTSMEs. For example, the internalisation advantage in the envelope paradigm builds on the internalisation theory (Buckley and Casson, 1976), which is an acknowledged theoretical approach in research concerning the FDI activities of HTSMEs (see Table 3.2). Furthermore, the ownership paradigm of the envelope paradigm is closely related to the RBV, KBV and dynamic capabilities perspective (Lundan, 2010; Majeed, 2011). These approaches have been individually adopted and empirically validated in numerous HTSME internationalisation studies (see Tables 3.5, 3.6, 3.7). The envelope paradigm further embraces location theory, which has been identified by many scholars as highly relevant in HTSME internationalisation research (Al-Laham and Souitaris, 2008; Delgado et al, 2010; Galbraith et al, 2008; Main et al, 2010) and it incorporates the network theory (Dunning, 2003), a fundamental component in the explanation of the international activities of HTSMEs (see Table 3.4).

Finally, the arguments listed above seem to be valid to counterargument critics towards the adoption of the paradigm in HTSME internationalisation research. The reason for criticism was partly based on the fact that highly cited articles synthesising theoretical approaches to SME internationalisation have solely discussed the applicability of the outdated versions of the paradigm, partly due to the year of their publication which was before the updates of the paradigm (see Andersen, 1993; Coviello and McAuley, 1999; Dana et al, 1999; Miesenbock,

1988; Ruzzier et al, 2006; Whitelock, 2002). This could be an explanation that the vast amount of prior HTSME internationalisation studies have not considered the more updated versions of the envelope paradigm (Dunning, 2000; 2003; 2004; Dunning and Lundan; 2008) as a possible framework for an empirical investigation. Instead, studies have often discussed and neglected the outdated versions of the eclectic paradigm (Dunning, 1977, 1988). Accordingly, a generally adverse position of SME researchers towards the OLI paradigm has developed over the years. However, as outlined above, implications derived from more recent literature highlight that the adoption of the updated envelope paradigm framework could be suitable to investigate the different types of FDI of HTSMEs. Therefore, the following chapter develops a conceptual envelope paradigm framework to be tested in the empirical part of this study.

4 Conceptual framework: The envelope paradigm in a HTSME context

4.1 Foundation of the framework

The process of carefully developing a logical model for an empirical study has been outlined as a key element of the research process in the field of international business (Bello and Kostova, 2012). Therefore, this chapter elaborates on the research hypotheses to be tested with the empirical data and concludes with the presentation of a configured envelope paradigm framework to address the overall research aim and objectives. As the findings of the literature review showed, the FDI of HTSMEs is influenced by the HTSME's O-advantages and the host country's L-advantages. Hence, this study draws on the impact of these advantages in order to explain the asset-exploiting and asset-augmenting FDI patterns of HTSMEs. The configuration of relevant O and L-advantages builds on the interpretation and integration of the theories and frameworks discussed in the literature review. More specifically, under the ownership perspective, the adopted envelope paradigm framework includes implications derived from internalisation theory (section 3.4.3.1), network theory (section 3.4.3.3), RBV (section 3.4.3.4), KBV (section 3.4.3.5) and dynamic capability perspective (section 3.4.3.6). Under the location perspective, the framework builds on implications of economic geography literature (Krugman, 1998; Porter, 1998), the innovation systems literature (Hall and Soskice, 2001) and the institutional perspective (North, 1990; Scott, 1995). The explanatory strength of these theoretical approaches in a HTSME context has been discussed in the respective sections of the literature review. Consequently, the following sections of the conceptual framework chapter build on this conceptual foundation of theoretical approaches via cross referencing. The following sections develop the research hypotheses to test the relationships between the adopted O and L-advantages and the HTSMEs' asset-exploiting and asset-augmenting FDI.

4.2 The ownership sub-paradigm

The theoretical foundation of O-advantages stems from the strategic management literature, particularly the resource-based approaches (Lundan, 2010; Peng, 2001). Furthermore, implications of network theory are partly influential as the firm's relational assets can function as an O-advantage as well (Dunning and Lundan, 2008). In the IB context, literature suggests that O-advantages have a major impact on the creation and sustainability of a firm's international competitiveness (Narula, 2012). Accordingly, O-advantages are defined as unique and sustainable firm-specific capabilities and assets, which provide the firm with a competitive advantage over its competitors in a foreign country (Arvanitis and Hollenstein, 2011; Dunning, 2000; Verbeke and Yuan, 2010). Hence, O-advantages inform the question 'why the firm invests abroad' (Eden and Dai, 2010). Extant IB literature provides a plenitude of O-advantages to investigate this question in different research settings. Some O-advantages are static and relate to traditional rent yielding advantages such as technological knowledge (differentiated products), advantages of common governance (advantages of scale and scope), firm size, international experience, marketing knowledge and the capability to coordinate international transactions efficiently (Galan and Gonzales-Benito, 2006; Narula, 2010; Wrona and Trapeczynski, 2012). Traditional IB research has commonly adopted these static O-advantages to explain the FDI of large production MNEs.

Other O-advantages are more dynamic in nature and relate to several theoretical advancements of the envelope paradigm (see Buckley and Hashai, 2009; Cantwell and Narula, 2001; Dunning, 2000; Dunning and Lundan, 2008; Narula, 2012; Stoian, 2013). The dynamic O-advantages refer to knowledge related to intangible assets and capabilities of the firm such as the R&D intensity, dynamic capabilities and the internal and external knowledge networks (Arvanitis and Hollenstein, 2011; Narula, 2012; Narula and Santangelo, 2012). In summary, Child and Rodrigues (2005:383) suggest, "Ownership advantages are firm-specific factors such as superior proprietary resources or managerial

capabilities that can be applied competitively in a foreign country”. More precisely, Arvanitis and Hollenstein (2011:609) outline that O-advantages “arise from the availability of (firm-specific) human, physical and knowledge capital as well as specific intangibles related to property rights, marketing, organization, learning, managerial skills, governance and trust, finance, experience with foreign markets, etc.” The flexible nature of the envelope paradigm allows the configuration of specific sets of O-advantages related to the underlying research context, the different types of FDI of HTSMEs. The following sections develop the research hypotheses around the O-advantages related to asset-exploiting FDI and asset-augmenting FDI to investigate the FDI of HTSMEs. The hypotheses development builds on the implications of the relevant theories in the HTSME context discussed in the literature review.

4.2.1 O-advantages related to asset-exploiting FDI

The first set of hypotheses addresses the HTSME’s O-exploiting advantages, which are organised under the first pillar of the conceptual framework labelled ‘O-advantages relevant to asset-exploiting FDI’ (see Figure 4.1). These advantages are product differentiation, technology adaptation, ability to develop patents, HQ support of foreign sales and production and economies of scale. Following the resource-based view of the firm (section 3.4.3.4), these O-advantages are seen as firm-specific resources and capabilities that enable the HTSME to outperform its competitors in the host market. Therefore, theory suggests that HTSMEs undertake market seeking and efficiency seeking FDI (as elaborated in section 3.4.5.3) as they seek to exploit these existing O-advantages across borders (Dunning, 2000). Accordingly, the arrows in the conceptual framework (Figure 4.1) visualise how the market- and efficiency seeking FDI reasons relate the HTSME’s O-exploiting advantages with the host country’s L-exploiting advantages. The following sections develop the hypotheses

concerning the association between O-exploiting advantages and the asset-exploiting FDI of HTSMEs.

Product differentiation

The product differentiation advantage draws on the work of Caves (1971) who showed that differentiated products constitute a monopolistic advantage. It holds that imperfect competition leverages product differentiation activities of the firm and its engagement in FDI. Furthermore, it is in accordance with the Schumpeterian view of competition, which suggests that a firm's failure of achieving competitive advantage through differentiated innovation results inevitably in the destruction of the firm (Schumpeter, 1934). This implies for an internationalised HTSME that a differentiated product range diminishes the likelihood of failure as the level of competition can be decreased through diversification (Majeed et al, 2011; Wrona and Trapczynski, 2012). Furthermore, differentiated products allow the firm to charge higher prices and thus to maximise returns (Nachum and Wymbs, 2005). Particularly in the specialised niche markets in the high-tech sector, product quality and functionality enjoy a very high premium (Luk et al, 2008). This allows HTSMEs to cover extensive costs related to the internationalisation via equity entry mode (Majeed et al, 2011; Pinho, 2007). Hence, it is expected that higher degrees of product differentiation are positively related to higher control modes in foreign operations (Narula and Santangelo, 2012; Pinho, 2007; Wrona and Trapczynski, 2012). It allows the HTSME to capitalise its firm-specific assets in the foreign market without being exposed to the danger of losing the firm-specific knowledge to a host country partner (Oerlemans and Meeus, 2005). This leads to the hypothesis:

Hypothesis 1a: The HTSME's ability to develop differentiated products is positively related to its engagement in asset-exploiting FDI.

Technology adaptation

The ability to adapt firm-specific technology to local demand facilitates the HTSME's exploitation of its core technology developed in the headquarters across domestic borders (Le Bas and Sierra, 2002; Rammer and Schmiele, 2008; Wrona and Trapczynski, 2012). This claim builds on the implications of internalisation theory discussed in section 3.4.3.1. It suggests that FDI emanates from the firm's possession of a competitive advantage achieved through superior technology in the home base. Accordingly, due to minor adaptations of the superior technology to local requirements, the firm is able to enhance asset-exploitation across borders (Dunning, 1988). Literature referred to this type of activity as international adaption R&D (Chiesa, 1996) and foreign product adaptive R&D (Hewitt, 1980). In high-tech industries, the adaptation of a product to customer requirements mainly refers to the handling of the product and the addition of minor customised functions ('add-ons'). It can also relate to adjustments due to diverse government regulations in the host country, which is a common reason for product adaptation in high-tech sectors (Al-Laham and Souitaris, 2008; Gassmann and Keupp, 2007). In contrast, the adaptation of the layout and design, which is significant for e.g. consumer products, is of minor importance in high-tech sectors. The implications discussed above lead to the hypothesis:

Hypothesis 1b: The HTSME's ability to adapt firm-specific technology to foreign markets is positively related to its engagement in asset-exploiting FDI.

Patent development

The HTSME's ability to develop patents allows the firm to secure and maintain its firm-specific technology while exploiting its competitive advantage in foreign markets. As defined by the OECD (1993:112), a patent is "A right granted by a government to an inventor in exchange for the publication of the invention; it entitles the inventor to prevent any third party from using the invention in any way, for an agreed period." Thus, patenting provides

a strategic choice for HTSMEs to claim property rights, diminish imitation, facilitate licensing, and establish bargaining power for negotiations (Dunning, 1993; VonHippel, 1988). Hence, the ability to develop patents provides a competitive advantage for the HTSME over indigenous firms in the host country and ascertains the intellectual property rights of firm-specific assets. This security is highly significant in high-tech industries as they are extremely competitive containing a ‘winner-takes-it-all’ mentality (Cannone and Ughetto 2014; Haeusler et al, 2012). This means, first mover advantage and exploitation of a protected innovative advantage is fundamental for HTSMEs long-term competitiveness (Li et al, 2012). This leads to the hypothesis:

Hypothesis 1c: The HTSME’s ability to develop patents is positively related to its engagement in asset-exploiting FDI.

Internal support structure

The internal support structure between headquarters and subsidiary creates opportunities to adapt existing sales and production strategies to particular conditions in the host country (Medcof, 1997). This support oriented factor enables the subsidiary to exploit the firm-specific advantages more efficiently by using the accumulated expertise located in the HTSMEs headquarters (Ito and Wakasugi, 2007; Iwasa and Odagiri, 2004; Kumar, 2007). Moreover, the sales and production expertise provided within the internal support structure can assist the subsidiary in meeting regulatory burdens entailed by the host country government. Particularly in the high-tech sector, regulations around production and sales of high-tech products can be very restrictive (Al-Laham and Souitaris; 2008; Gassmann and Keupp, 2007). Meeting the regulations is a complex task for small subsidiaries of HTSMEs due to the intricate nature of high-tech products and markets (Al-Laham and Souitaris; 2008; Gassmann and Keupp, 2007). Therefore, the expertise and support from the headquarters is

an essential advantage for the effective organisation of the foreign asset-exploitation (Kumar, 2007). This leads to the hypothesis:

Hypothesis 1d: The HTSME's ability to provide an internal support structure is positively related to its engagement in asset-exploiting FDI.

Economies of scale

The HTSME's advantage of exploiting economies of scale is based on classical location and internalisation theory (discusses in section 3.4.3.1). It holds that firms engage in efficiency seeking FDI in order to reduce overall production costs and has been one of the most generally accepted hypothesis in international business research (Dunning and Lundan, 2008). For a HTSME, scale economies can become a significant advantage when it has reached a critical output mass (Khilji et al, 2006; Pla-Barber and Alegre, 2007). This can be achieved through cumulative learning and specialisation (Saarenketo et al, 2004). As Saarenketo et al (2004:375) outline, for HTSMEs there has been a "shift of the focus from the economies of scope to the economies of scale as main explanatory factors of the internationalization process. This can be explained in terms of the need for more and more specialized capabilities fostered through partial replication processes." Hence, being able to take advantage of scale economies allows the HTSME to facilitate its asset-exploitation in foreign markets. This leads to the hypothesis:

Hypothesis 1e: The HTSME's ability to take advantage of scale economies is positively related to its engagement in asset-exploiting FDI.

4.2.2 O-advantages related to asset-augmenting FDI

The second set of hypotheses relates to the O-advantages organised under the second pillar of the conceptual framework labelled 'O-advantages relevant to asset-augmenting FDI' (see

Figure 4.1). These O-advantages are innovative capability, R&D network, absorptive capacity, internal knowledge network and ability to apply the foreign knowledge contributions. In line with the theoretical implications of the knowledge-based view, these O-augmenting advantages are crucial for the HTSME's ability to create and manage knowledge related resources (as discussed in section 3.4.3.5). Moreover, following the dynamic capabilities perspective (section 3.4.3.6), these O-advantages are the tools to acquire, integrate and apply the foreign knowledge assets in the HTSME. Hence, theory implies that these O-augmenting advantages are relevant for the HTSME's strategic asset seeking FDI (as discussed in section 3.4.5.4). Accordingly, the arrows in the conceptual framework (Figure 4.1) visualise how the strategic asset seeking FDI reason relates the HTSME's O-augmenting advantages with the host country's L-augmenting advantages. The following sections develop the hypotheses concerning the association between O-augmenting advantages and the asset-exploiting FDI of HTSMEs.

Innovative Capability

From the knowledge-based perspective, HTSMEs require a certain amount of innovative capabilities in order to be able to conduct strategic asset-seeking activities (section 3.4.5.4). The firm's innovative capability builds on its experience and prior learning in knowledge related areas (Alegre et al, 2011; Saarenketo et al, 2004). Previous research has identified a high degree of R&D intensity and R&D related personnel in the firm as a key aspects of innovative capability (Haeusler et al, 2012; Marvel and Lumpkin, 2007). Accordingly, following the notion of the knowledge-based view (section 3.4.3.5), this indicates that the HTSME's innovative capability derived from its R&D related activities can significantly influence the dynamics of its foreign knowledge augmentation. Specifically, the stock of R&D related personnel represents the HTSME's accumulated capabilities in creative thinking and problem solving in international knowledge sourcing processes (Filatotchev et

al, 2011). This supports the HTSME's engagement of the firm in asset-augmenting FDI and leads to the hypothesis:

Hypothesis 2a: A higher innovative capability of the HTSME is positively related to its engagement in asset-augmenting FDI.

R&D network

The asset-augmenting FDI can be positively influenced by the firm's existing R&D network (Chang, 2003; Phene and Almeida, 2008). In line with the theoretical propositions of the network theory (section 3.4.3.3), it is expected that the HTSME's experience and skills and cooperating with R&D partners in host locations has a positive impact on the engagement and organisation of knowledge networks and asset-augmenting FDI (Gilbert et al, 2008). Cooperation partners for HTSMEs can vary across different sectors containing universities, private or state-owned scientific institutions, customers, suppliers, and competitors (Oerlemans and Meeus, 2005). The previous established contacts and expertise in dealing with the R&D partners enhances the HTSME's abilities in mutual learning and facilitates its access to foreign knowledge networks. Furthermore, having a larger R&D network enables the firm to monitor the newest technological developments in their field (Buckley and Ghauri, 2004; Fritsch and Lukas, 2001). Hence, it enables the HTSME to structure its asset-augmenting FDI more efficiently with a specific focus on relevant knowledge to be acquired. This advantage can be increased through R&D cooperation with other private or public institutions in the field (Saxenian, 1990). This leads to the hypothesis:

Hypothesis 2b: A larger R&D network of the HTSME is positively related to its engagement in asset-augmenting FDI.

Absorptive capacity

Absorptive capacity is defined as the firm's "ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990:128). Following the implications of the dynamic capabilities perspective (section 3.4.3.6), the HTSME's absorptive capacity can be seen as the 'eyes and ears' of the firm that help to strengthen, reconfigure, and adjust its knowledge base (Lane et al, 2006). Therefore, it is an important factor of successful strategic asset seeking FDI as it depends on the firm's ability to identify and critically assess the relevance of external knowledge in the host country, followed by its acquisition and integration (Makino et al, 2002). Hence, the HTSME's absorptive capacity is a competitive advantage that leverages the innovation activities (Liu and Buck, 2007; Narula, 2012; Schmiele, 2012). It allows the firm to incorporate a wider range of relevant knowledge and to facilitate innovation functions more effectively (Ambos et al, 2006; Ito and Wakasugi, 2007; Mahnke et al, 2005). This leads to the hypothesis:

Hypothesis 2c: A higher absorptive capacity of the HTSME is positively related to its engagement in asset-augmenting FDI.

Internal knowledge network

The internal knowledge network draws on the theoretical developments of 'technological linkages' (Zollo and Winter, 2002) and 'organisational memory' (Stein and Zwass, 1995). It relates to the HTSME's ability to coordinate knowledge and to facilitate its use between the headquarters and subsidiary (Arvanitis and Hollenstein, 2011; Meyer et al, 2011). The efficiency of the HTSME's internal knowledge network is dependent on the technological linkages between firm units and the degree of organisational memory (Cegarra-Navarro and Sánchez-Polo, 2011). Scientists and managers from the headquarters and subsidiary must be willing to share knowledge with each other (Reinholt et al, 2011). This can occur through

personal meetings, the use of digital communication channels or by shifting employees across borders (Criscuolo and Narula, 2007; Noorderhaven and Harzing, 2009). Hence, a strong internal knowledge network enables asset-augmenting HTSMEs to overcome what Von Hippel (1994) calls the problem of ‘sticky knowledge’. It refers to the problems related to the acquisition and transfer of information and problem-solving capabilities between locations. Additionally, strong internal network relations provide the HTSME the ability to translate the knowledge gained from external sources into a form that is understandable for all departments and individuals within the firm (Bathelt et al, 2004). This leads to the hypothesis:

Hypothesis 2d: A stronger internal knowledge network of the HTSME is positively related to its engagement in asset-augmenting FDI.

Foreign knowledge Implementation

The HTSMEs ability to implement the foreign knowledge is in line with the assumptions of the ‘dynamic learning’ perspective (Minniti and Bygrave, 2001), which falls under the dynamic capabilities of the HTSME discussed in section 3.4.3.6. In the entrepreneurial context of dynamic learning, Cope (2005:377) differs between two temporal phases of learning; “learning prior to start-up and learning during the entrepreneurial process.” The ability to implement foreign knowledge falls under the latter phase. It asserts that the augmented knowledge is only of value for the HTSME when its scientific engineers are able to implement it in the process of new product development. Hence, it is the final step in the foreign asset-augmentation process (Arvanitis and Hollenstein, 2011). Oerlemans and Meeus (2005) describe this process as the ‘external contribution to the innovation process’. They highlight that e.g. R&D cooperation in itself do not directly contribute to the innovation process through knowledge transfer. These are rather preconditions for the firms to interact and evaluate if communication channels for possible knowledge transfers are available. If

this precondition is fulfilled, the HTSME must have the ability to implement the external knowledge in its internal innovation processes (Oerlemans and Meeus, 2005). This leads to the hypothesis:

Hypothesis 2e: The HTSME's ability to implement the knowledge accessed abroad in the product and patent development process is positively related to its engagement in asset-augmenting FDI.

4.3 The location sub-paradigm

This section discusses the location sub-paradigm of the conceptual framework in order to develop the research hypotheses, which address the question 'where' HTSMEs undertake FDI. Location advantages (L-advantages) relate to factor endowments, which reflect the attractiveness of a location for FDI (Narula and Santangelo, 2012). As Arvanitis and Hollenstein suggest (2011:609), "L-advantages represent potential gains a firm can realize by optimizing its activities along the value chain across locations." From a traditional IB perspective, L-advantages concern location factors related to efficiency seeking, market seeking and resource seeking FDI. The efficiency seeking firm aims to exploit arbitrage opportunities of factor endowments in foreign locations (Arregle et al, 2009). Thus, it can increase the advantages gained from economies of scale and scope through relocation of operations to low cost countries (Jensen and Pedersen, 2011). Accordingly, the focus is on static L-advantages such as lower costs of production and transportation, trade barriers, incentives by host governments etc. (Li et al, 2011). The market seeking firm targets locations that provide a large market size, high demand patterns and market development potential (Ellram et al, 2013; Kang and Jiang, 2012). However, Driffield and Love (2007) highlight that the market seeking firm requires a competitive advantage over indigenous firms in order to exploit these L-advantages. The natural resource seeking firm can be neglected in this study as value chain activities of HTSMEs do not require large inputs of

natural resources (as outlined in section 2.3). Therefore, the focus of this study lies on static L-advantages related to the efficiency seeking FDI and market seeking FDI.

Further, more recent advances of location theory in IB research have emphasised the importance of dynamic L-advantages (Dunning and Lundan, 2008; Narula and Santangelo, 2009). These are knowledge related factor endowments such as the scientific, industrial and political infrastructure supporting the firm's exploration of new technologies and technological processes (Narula and Santangelo, 2009, 2012). These facilitate the creation of dynamic O-advantages, which maintain and extend the HTSME's income generating assets over time. In the words of Dunning (1998:54), "... as strategic asset-acquiring investment has become more important, the locational needs of corporations have shifted from those to do with access to markets, or to natural resources, to those to do with access to knowledge-intensive assets and learning experiences, which augment their existing O specific advantages." The theoretical underpinnings of the dynamic L-advantages and the spatial organisation of foreign asset-augmenting activities are anchored in the literature concerning clusters (Porter, 1990), national systems of innovation (Hall and Soskice, 2001) and institutional theory (North, 1990). The sections developing the hypotheses related to the L-augmenting advantages will discuss the implications of these relevant streams in literature in detail. The next section commences with the development of the hypotheses related to the L-exploiting advantages.

4.3.1 L-advantages related to asset-exploiting FDI

The third set of hypotheses concerns the L-advantages accumulated under the third pillar of the conceptual framework labelled 'L-advantages important for asset-exploiting FDI' (see Figure 4.1). These L-advantages are cost factors and market factors. They build on the traditional location theory suggesting that firms in possession of a competitive advantage seek to undertake FDI in host locations, which offer advantages in terms of market size and

cost efficiency. Therefore, it is expected that firms in possession of these advantages engage in market seeking FDI and efficiency seeking FDI (see section 3.4.5.3). Accordingly, the arrows in the conceptual framework (Figure 4.1) visualise how the market- and efficiency seeking FDI reasons relate the host country's L-exploiting advantages with the HTSME's O-exploiting advantages. The following sections develop the hypotheses concerning the association between the L-exploiting advantages and the asset-exploiting FDI of HTSMEs.

Market factors

The theoretical propositions related to market seeking FDI (Hymer, 1976) hold that market factors such as market size and market growth potential determine the foreign location choice of the firm from an asset-exploiting perspective (Galan et al, 2007; Kang and Jiang, 2012). Hence, the size and the growth potential of the foreign market has traditionally been seen as highly significant for the asset-exploiting FDI streams to a country (Kang and Jiang, 2012; Rugman, 2010; Stoian and Filippaios, 2008; Wrona and Trapczynski, 2012). In the particular HTSME context, the market size of the potential host country was determined as the most significant factor to explain foreign market entry of HTSMEs (Ojala and Tyrvaenen, 2008). Furthermore, the establishment of a subsidiary in a highly attractive market provides the HTSME with an advantage over competitors trying to get a foothold in this market (Majeed et al, 2011). Pinho (2007) points out that a high growth potential in the foreign market leverages the resource commitment of SMEs in this market. This is in line with other scholars who hold that the sales and growth potential of a foreign market has a significant influence on the entry of SMEs due to the expected long-term profitability in these markets (Kang and Jiang, 2012; Majeed et al, 2011; Nakos and Brouthers, 2002). This leads to the hypothesis:

Hypothesis 3a: The market size and market growth potential in the host country are positively related to the attraction of asset-exploiting FDI of HTSMEs.

Cost factors

Referring to traditional IB theory, the rationalised or efficiency seeking FDI allows the HTSME to take advantage of cost factors in the host country (see section 3.4.3.1). In the specific HTSME context, these factors particularly relate to lower production and adaptive R&D costs while other costs such as costs for raw materials, transport, etc are not relevant in the HTSME context (Arvanitis and Hollenstein, 2011; Di Gregorio et al, 2009; Wrona and Trapczynski, 2012). The theoretical propositions of the economic geography field provide further insights to the relationship between location and cost advantages. As Krugman (1998) highlights, input costs relate to market forces, which determine the location of a firm's cross border activities. Therefore, it is likely that firms shift production and adaptive R&D functions to countries, which are in a transition from traditional to advanced economies (Asakawa and Som, 2008; Kenney et al, 2009; Qu et al, 2013). The reason is that "low-cost locations in Asia are able to attract advanced, high-value activities due to the availability of highly skilled staff (Jensen and Pedersen, 2011:354)." Therefore, it is expected that the existence of efficiency related cost factors in the host country attract the asset-exploiting FDI of HTSMEs. This leads to the hypothesis:

Hypothesis 3b: Lower production and adaptive R&D costs in the host country are positively related to the attraction of asset-exploiting FDI of HTSMEs.

4.3.2 L-advantages related to asset-augmenting FDI

The fourth set of hypotheses addresses the L-advantages accumulated under the fourth pillar of the conceptual framework labelled 'L-advantages important for asset-augmenting FDI' (see Figure 4.1). In line with the notions of the economic geography literature (Krugman, 1991, 1998; Porter, 1990) and the national systems of innovation literature (Hall and Soskice, 2001), the following L-advantages were identified as significant for the HTSME's

strategic asset seeking FDI: Institutional environment, abundance of highly skilled human capital, proximity to innovative institutions and firms, proximity to innovative suppliers, proximity to industrial concentrations and home country disadvantage. In accordance with the strategic asset seeking perspective (section 3.4.5.4), it is expected that these L-advantages are important for the asset-augmenting FDI of HTSMEs. Accordingly, the arrows in the conceptual framework (Figure 4.1) visualise how the strategic asset seeking FDI reason relates the host country's L-augmenting advantages with the HTSME's O-augmenting advantages. The following sections develop the hypotheses reflecting these relationships.

Institutional environment

The institutional environment in a country sets the regulative, cognitive and normative mechanisms governing the behaviour of the firm (North, 1990; Scott, 1995). Therefore, it is expected that the quality of the institutional environment has a strong impact on inward FDI streams as it mitigates risk and uncertainties for the investing firm (Faeth, 2009; Holmes et al, 2013; Narula and Santangelo, 2012). In the specific case of the FDI of HTSMEs, the legal system and government policies related to innovation activities are particularly important (Moncada-Paternò-Castello, 2011). These set the institutional conditions around security standards, R&D and production procedures, final product approval and export regulations (Al-Laham and Souitaris, 2008; Cleff et al, 2007; Gassmann and Keupp, 2007). Hence, HTSMEs are expected to undertake asset-augmenting FDI in host countries where they can reduce constraints of these regulatory burdens and red tape to innovation activities (Al-Laham and Souitaris, 2008; Coeurderoy and Murray, 2008; Narula and Santangelo, 2012). Furthermore, HTSMEs are expected to invest in countries where the institutional environment facilitates the protection of knowledge assets and intellectual property (Du et al, 2012; Rammer and Schmiele, 2008; Wrona and Trapczynski, 2010). Weaker intellectual

property protection would result in an unfavourable condition for asset-augmenting FDI of HTSMEs, as it reduces the profitability of new technological knowledge (Courderoy and Murray, 2008; De Jong and Von Hippel, 2009; Ito and Wakasugi, 2007). This leads to following hypothesis:

Hypothesis 4a: An institutional environment conducive to innovation activities in the host country is positively related to the HTSME's engagement in asset-augmenting FDI.

Abundance of highly skilled human capital

The relative abundance of highly skilled human capital in a location has a stimulating effect on strategic asset seeking FDI (Arvanitis and Hollenstein, 2011; Hatem, 2011; Narula and Santangelo, 2012; Teixeira and Heyuan, 2012). Therefore, based on the literature linking economic geography and human capital theory (Acs and Armington, 2004; Florida, 2002; Teixeira and Heyuan, 2012), it is expected that HTSMEs undertake asset-augmenting FDI in locations where they can access a pool of highly skilled human capital. This is in line with Kuemmerle's (1999:1275) proposition that overseas R&D "aims to generate technological knowledge by accessing expertise that exists in the local science base and hiring skilled engineers and scientists from the local market." Theoretical underpinnings can be derived from the knowledge-based view suggesting that the shared knowledge between individuals and groups within the firm is the most valuable resource of the firm (see section 3.4.3.5). Furthermore, the organisational learning perspective suggests that organisations accumulate knowledge by learning from their members over time (March, 1991; Zollo and Winter, 2002). Previous empirical evidence showed that the count of highly educated labour (doctorates scientists and engineers) in a location attracts knowledge seeking FDI (Chung and Alcacer, 2002; Hatem, 2011; Narula and Santangelo, 2012). The aggregation of specialised knowledge in a location is often followed by a boost of specific educational

activities in this location (Lorenzen and Mahnke, 2002). Accordingly, this has a leveraging effect on the quantity and quality of the highly skilled human capital in the location. This leads to the hypothesis:

Hypothesis 4b: The abundance of highly skilled human capital in the host country is positively related to the HTSME's engagement in asset-augmenting FDI.

Cluster aspects

This study develops three hypotheses (H4c, H4d, H4e) to reflect prominent cluster aspects (Krugman, 1991, 1998; Porter, 1990) in the L-augmenting paradigm.

Proximity to scientific institutions and innovative firms

Following the assumptions of the cluster strand of the economic geography literature (Krugman, 1998; Porter, 1998) and the innovation systems literature (Hall and Soskice, 2001), it is expected that HTSME undertake asset-augmenting FDI in locations where the local environment provides the specialised resources required to explore new knowledge and capabilities. Hence, collocations of innovative industry related firms and public and private research institutes are supposed to attract the asset-augmenting FDI of HTSMEs. The proximity to these institutions facilitates interaction and enables the HTSME to take advantage of highly specialised resource endowments, knowledge networks and cooperations in the host country (Florida, 2002; Delgado et al, 2012). This reasoning has proven fertile in prior research to explain the foreign location decision of the firm by relating theoretical assumptions of network theory (section 3.4.3.3) and knowledge-based view (section 3.4.3.5). It suggests that firm specific networks and relational assets can be seen as O-advantages of the firm (Dunning, 2003). Thus, the quantity and scientific quality of host country institutions and firms reflects the attractiveness of a foreign location for asset-augmenting FDI (Hatem, 2011). Therefore, it is expected that being proximate to these

institutions leads to an increase of the HTSME's innovative activities (Bathelt et al, 2004), as spatial collocations often develop in lead markets where innovations are initiated (Klepper, 2010). This leads to the hypothesis:

Hypothesis 4c: Proximity to scientific institutions and innovative firms and in the host country is positively related to the HTSME's engagement in asset-augmenting FDI.

Proximity to innovative suppliers

In line with the theoretical development of Hypothesis 4c above, it is expected that the proximity to innovative suppliers is a further important L-augmenting advantage that can be enhanced in a cluster (Porter and Sölvell, 1998). Accordingly, its theoretical underpinning stems from the cluster strand of the economic geography literature (Porter, 1998; Saxanian 1994) and the innovation systems literature (Hall and Soskice, 2001) suggesting that the firm's proximate location to innovative suppliers has a positive impact on its innovation activities (Von Hippel, 1988). Innovative suppliers can provide important inducements for HTSMEs to develop new innovations using the location specific knowledge and expertise of the suppliers (Hollenstein, 2009). The formal and informal knowledge networks with the innovative suppliers are key aspects in this process (Cantwell and Piscitello, 2005). The territorial closeness to these suppliers facilitates the HTSME's ability to transfer and receive knowledge and it encourages its risk taking and sharing (Oerlemans and Meeus, 2005). This argumentation finds ample support in the network theory (section 3.4.3.3) and knowledge-based view (section 3.4.3.5). This leads to the hypothesis:

Hypothesis 4d: Proximity to innovative suppliers in the host country is positively related to the HTSME's engagement in asset-augmenting FDI.

Proximity to industrial concentrations

Following the theoretical development of the Hypotheses 4c and 4d, the proximity to industrial concentrations is the last of the three L-augmenting advantage that can be enhanced in a cluster. Concordant with the previous two cluster parameters, it builds on the economic geography literature (Porter, 1998; Saxanian 1994) and innovation systems literature (Hall and Soskice, 2001). It suggests that a high industrial concentration in the host location provides Marshallian spatial externalities such as knowledge spillovers, a superior pool of available inputs, external scope economies and reduction of transaction costs (Fingleton et al, 2004; Gilbert et al, 2008). Furthermore, the geographical agglomeration of related industries has a positive impact on the competitiveness and growth of firms located in this agglomeration (Acceturo, 2010; Narula and Santangelo, 2012). The reason is that innovation hardly occurs in isolation of the firm (Chang, 2003). Rather, innovation and firm growth are triggered by a pool of specialised inputs provided by organisations in industrial concentrations of related industries (Delgado et al, 2010). The joint significance of these industry factors concentrated in a specific location contributes to the overall quality of the industrial environment (Narula and Santangelo, 2012). Hence, the spatial interaction and structure of the host country's high-tech sector has a significant impact on the asset-augmenting FDI of HTSMEs (Hatem, 2011). This leads to the hypothesis:

Hypothesis 4e: Proximity to industrial concentrations in the host country is positively related to the HTSME's engagement in asset-augmenting FDI.

Home country disadvantage

The national systems of innovation literature distinguishes in its varieties of capitalism framework between coordinated market economies (CMEs) and liberal market economies (LMEs) (Hall and Soskices, 2001; Nelson, 1993). CMEs support incremental innovation processes where the establishment of quality in an existing product line and the stepwise

improvement of products and processes is the major concern. In contrast, LMEs rely on market competition and hierarchies in the market structure and therefore support radical innovation in the quest for new products and changes in production processes (Edquist, 2005; Hall and Soskices, 2001). Therefore, it is expected that HTSMEs located in CMEs such as Germany undertake asset-augmenting FDI in LMEs such as the US in order to overcome the limitations of their home market in relation to technological development (Akkermans et al, 2009; Reiss and Hinze, 2004). These limitations concern deficits of the environment related to innovation such as lack of highly skilled labour, high innovation costs or high governmental regulations (Kampik and Dachs, 2011; Meyer, 2011; Rammer and Schmiele, 2008). Hence, following the logic of home-base compensating R&D as described by Lehrer et al (2011), HTSMEs undertake asset-augmenting FDI to balance out the deficits and constraints to innovation in their home country (Arvanitis and Hollenstein, 2011). These obstacles in the home country can therefore function for HTSMEs as FDI push factors, to take advantage of the superior host country innovation-specific resources (Schmiele, 2012). Therefore, research should additionally investigate home country characteristics in order to determine why HTSMEs from different countries engage in different types of FDI (Brouthers and Nakos, 2004). This leads to following hypothesis:

Hypothesis 4f: The home country disadvantage is positively related to the HTSME's engagement in asset-augmenting FDI.

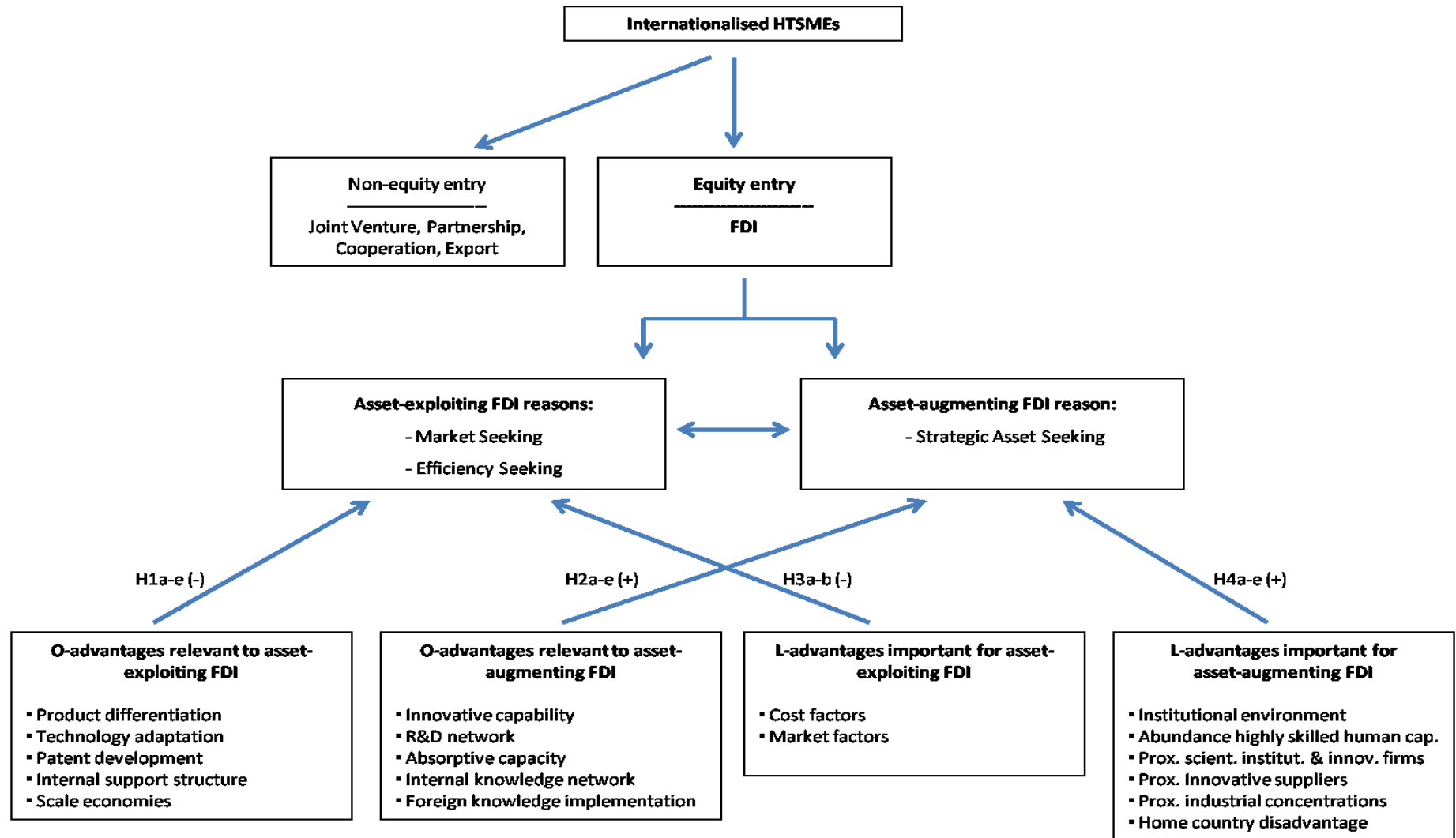
Table 4.1 Summary of hypotheses

Hypothesis	Independent variable	Dependent variable	Hypothesised relationship
H1a	Product differentiation	Type of FDI	Exploiting FDI
H1b	Technology adaptation	Type of FDI	Exploiting FDI
H1c	Patent development	Type of FDI	Exploiting FDI
H1d	Internal support structure	Type of FDI	Exploiting FDI
H1e	Scale economies	Type of FDI	Exploiting FDI
H2a	Innovative capability	Type of FDI	Augmenting FDI
H2b	R&D network	Type of FDI	Augmenting FDI
H3c	Absorptive capacity	Type of FDI	Augmenting FDI
H3d	Internal knowledge network	Type of FDI	Augmenting FDI
H3e	Foreign knowledge implementation	Type of FDI	Augmenting FDI
H3a	Cost factors	Type of FDI	Exploiting FDI
H3b	Market factors	Type of FDI	Exploiting FDI
H4a	Institutional environment	Type of FDI	Augmenting FDI
H4b	Abundance skilled human capital	Type of FDI	Augmenting FDI
H4c	Prox. scient. institutions & innov. firms	Type of FDI	Augmenting FDI
H4d	Prox. innovative suppliers	Type of FDI	Augmenting FDI
H4e	Prox. industrial concentrations	Type of FDI	Augmenting FDI
H4f	Home country disadvantage	Type of FDI	Augmenting FDI

4.4 Summary

The sections above have developed the hypotheses stating the hypothesised relationships between the O- and L-advantages and the asset-exploiting and asset-augmenting FDI of HTSMEs. Figure 4.1 below outlines the conceptual framework adopted in this study. The O and L-advantages representing the hypotheses are summarised in the boxes at the bottom of the conceptual framework. The arrows show how the different advantages relate through the asset-exploiting and asset-augmenting FDI motivations of HTSMEs.

Figure 4.1 Conceptual framework



5 Methodology

5.1 Introduction

This chapter outlines and justifies the methodology adopted to inform the research problem, research questions and research hypotheses developed. The field of FDI and HTSMEs is understudied and requires an exploratory and explanatory design. Section 5.2 provides a general overview of the ontological and epistemological positions in IB research. It starts with a comparison of the objectivist and subjectivist paradigms, and a discussion and justification of scientific realism. Section 5.3 elaborates on the research design of the study. This is taken forward in section 5.4, which outlines the research methods and instruments. Section 5.5 outlines the operationalisation of the dependent and independent variables. Section 5.6 describes the response analysis and pre-estimation tests and section 5.7 outlines the statistical instrument for the analysis. Finally, section 5.8 summarises the chapter.

5.2 Ontology and epistemology

Different philosophical perspectives are associated with different views about the nature of knowledge creation and the limits of knowledge. Therefore, it is an important step for empirical studies to justify their underlying philosophical perspective in order to contribute valid knowledge (Little, 1991). As a foundation for the proceeding discussion, this section commences with definitions of the related key concepts ontology, epistemology and methodology (Blaikie, 1993; Burrell and Morgan, 1979).

Ontology refers to the assumptions that a research approach makes about the nature of social reality. It concerns questions about what exists and therefore deals with the basic elements of reality (Blaikie, 1993; Parkhe, 1993). Burrell and Morgan (1979) suggest that from an ontological perspective, researchers need to consider if the reality they investigate is external to the individual or the result of individual consciousness. Further, if the reality is objective or the result of individual cognition, and if reality is a creation of the individual mind or

based on external stimuli. Besides these ontological issues, epistemological assumptions are essential for any research project (Easterby-Smith et al, 2012).

Epistemology concerns the claims and assumptions of how to investigate this reality. It deals with the basis and characteristics of knowledge and seeks to provide a justification for what can be regarded as knowledge (Baker, 2003; Blaikie, 1993). Therefore, the epistemological considerations are crucial for the determination of an appropriate research methodology for this study. As Jean Lee (1992:88) highlights “All research methods embody a variety of epistemological assumptions regarding the nature of knowledge and the methods through which that knowledge can be obtained.” Easterby-Smith et al (2012) provide several reasons why an appropriate epistemological position is significant for the development of a sound research methodology to address the research problem. First, epistemology guides the research strategy and helps to determine suitable research methods for the investigation. Second, a rigorous evaluation of different epistemological approaches mitigates the risk of choosing an inappropriate methodology and research methods. Epistemology also facilitates the selection criteria by considering the limitations of the available approaches. Third, the researcher gains a wider understanding of the research problem and available empirical techniques to solve the problem. This increases the researcher’s options to find a creative and innovative research methodology to address and solve the research problem (Easterby-Smith et al, 2012).

The research methodology is defined as the combination and utilisation of techniques by the researcher to explore reality and to make sense of it (Blaike, 1993; Parkhe, 1993). Therefore, the methodological discourse concerns the question how we believe reality can be investigated through the adoption of specific research techniques (Fleetwood, 2005). A coherent research methodology is essential in order to conduct a consistent empirical investigation (Easterby-Smith et al, 2012). The methodological assumptions, in combination

with the assumptions related to ontology and epistemology have direct implications and consequences for the way the researcher investigates the social world to gather knowledge (Burrell and Morgan, 1979). These assumptions lead the researcher towards two key approaches related to the nature of science: The subjectivist and objectivist paradigm.

5.2.1 The subjectivist and objectivist paradigm

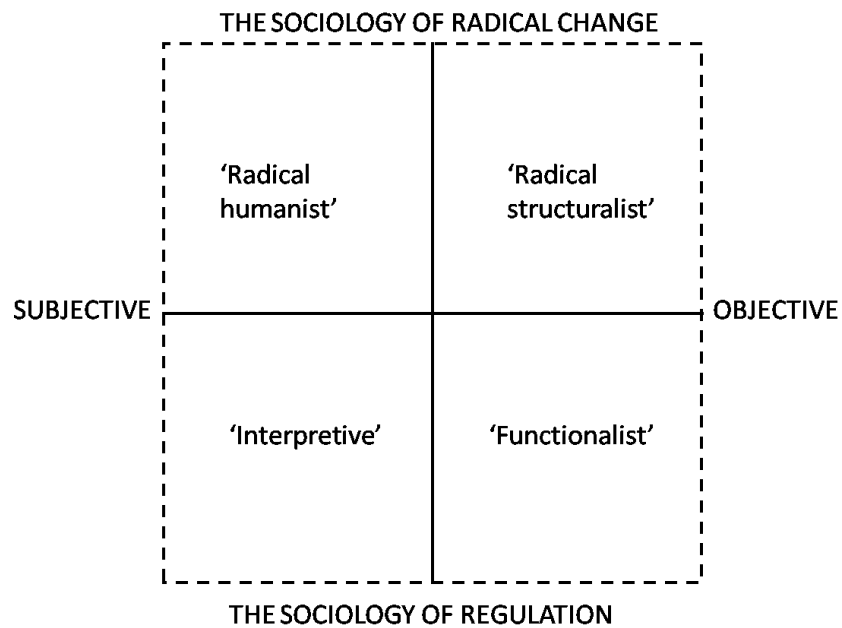
The subjectivist and objectivist dimension provide a foundation for the classification and understanding of social theories. Burrell and Morgan (1979) discussed the subjectivist/objectivist dimension in relationship with a regulation/radical change dimension, which is another main debate in sociology. It concerns the nature of society and approaches social theory from the perspectives of regulation and radical change (Gill and Johnson, 2002). Together, the two dimensions can be organised in a 2*2 matrix with four paradigms that provide a comprehensive scheme to organisational analysis (see Figure 5.2). Each of the four paradigms underlies specific meta-theoretical assumptions of ontology, epistemology, and methodology (as defined in section 5.2).

Burrell and Morgan (1979) suggest that theorists located in the 'Radical humanist' paradigm (subjective/radical change) are concerned with the development of a sociology of radical change from a standpoint that is nominalist, anti-positivist and ideographic. The 'Interpretive' paradigm (subjective/regulation) is defined by its concern to develop an explanation of the fundamental nature of the social world from the viewpoint of a subjective individual. Theorists within the 'Radical structuralist' paradigm (objective/radical change) advocate constant change, emancipation and potentiality within an analysis of structural conflict and contradiction. Finally, the 'Functionalist' paradigm (objective/regulation) has provided the primary framework for research in sociology and organisational study. It draws on a perspective of rational human action and the explanation of the status quo, social order and consensus. Its approach to social science follows the assumption that "the social world

is composed of relatively concrete empirical artifacts and relationships, which can be identified, studied and measured through approaches derived from the natural science” (Burrell and Morgan, 1979:26).

The underlying study can be placed in the Functionalist paradigm as it seeks to develop essentially rational explanation of relationships that lead to principles that influence everyday cognition (Gill and Johnson, 2002). In particular, this study argues that the HTSMEs adapt their different types of FDI to the existing system, instead of trying to adapt the system to their FDI. The ontological stance here is that the reality is external to the HTSMEs as it is imposed by external conditions (Sayer, 2000). Hence, the underlying assumption is that HTSMEs might not be conscious of certain structures, which labels and denotations do not have a meaning for them. However, these structures are tangible and mostly unchangeable (Gill and Johnson, 2002). They define and shape the reality of the world in which the HTSME operates in. Therefore, the success of the HTSME’s FDI is dependent on its ability to adapt to these structures. In order to understand these issues, theorists in the Functionalist paradigm take viewpoints related to realist, positivist and determinist perspectives to organisation analysis (Burrell and Morgan, 1979). This study particularly adopts a scientific realist perspective (McKelvie, 1997), which is a modified form of functionalism or positivism, to study the different types of FDI of HTSMEs. The following section introduces and discusses this perspective in detail.

Figure 2.1 Four paradigms for the analysis of social theory



Source: Adopted from Burrell and Morgan (1979:22)

5.2.2 Scientific realism

The epistemology of this study is rooted in scientific realism (Leplin, 1984; Suppe, 1989) as it is supposed to have several advantages over other positions such as positivism (McKelvie, 1997). Its logic-in-use in organisational research is close to positivism (Godfrey and Hill, 1995). The organisation scientific realist holds that continuous research approaches adopting commonly accepted methods of justification logic are supposed to reveal approximate truth of theories by incrementally reducing errors (McKelvie, 1997). Accordingly, in line with the evolutionary epistemology of Popper (1972), the epistemological stance of this study believes in the existence of a quasi-objective reality. Therefore, this study follows McKelvie (1997) who suggests that scientists should replace the vague notions of positivism with scientific realism, as it rests on idealised models (Suppe 1989). Researchers taking a positivist stance believe that “the world is objectively and unproblematically available and capable of being known by the systematic application of the empirical techniques common to positivism” (Ackroyd and Fleetwood, 2000:4). Positivism asserts that concepts are

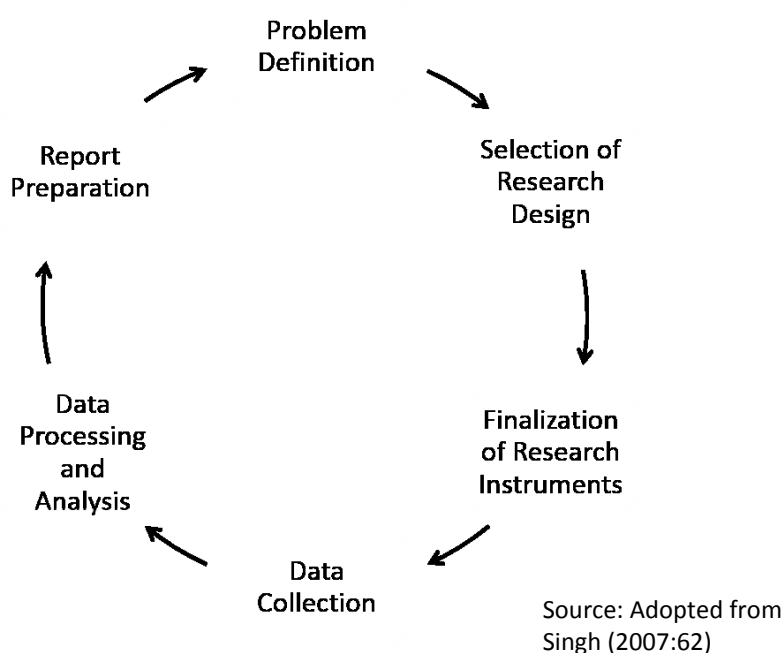
systematic in a predictable universe and its key concern is how to measure these concepts adequately (Sapsford and Jupp, 2006). In comparison, scientific realism implies that “the long term success of a scientific theory gives reason to believe that something like the entities and structure postulated by the theory actually exists” (McMullin, 1984:26). Its general assumption about a theory is that it is empirically testable and it is a systematically connected set of statements which often contain lawlike generalisations. This implies that the meaning of theory is to enhance scientific understanding with its systematic structure that is able to account for the explanation and prediction of phenomena (Hunt, 1991). In relation to organisation science, McKelvie (1997) argues that researchers often claim to follow an epistemology based on the positivist perspective, although their logic-in-use in empirical research is in-fact very close to scientific realism. Therefore, McKelvie (1997) suggests that positivism should be replaced by scientific realism. The underlying study follows this advice. The following section outlines how the scientific realism stance affects the research design of this study.

5.3 Research design

Having discussed the epistemological stance of this study, this section discusses how the research design aligns to the epistemology in order to address the research questions. Thus, this section relates the epistemological position and research problem to determine an appropriate research design (Easterby-Smith et al, 2012). This is in line with Van de Ven’s (2007) conceptualisation suggesting that the research problem and the research questions determine the research design for an empirical investigation. The research design outlines the plan, structure and strategy of the study to address the research problem and to gain meaningful results (Singh, 2007). This study follows Singh’s (2007) model of the process of social research. As visualised in Figure 5.3, the definition of the research problem (conducted in the introduction of this study) was followed by the selection of an appropriate

research design and research instruments to address and solve the identified research problem (sections 5.2 – 5.4). Subsequently, the key concepts are operationalised followed by a description of the data collection process (sections 5.5 – 5.6). Then chapter 6 provides the data processing and analysis, while chapter 7 presents the discussion of the data for the report of the results in chapter 8.

Figure 5.3 The social research process



5.3.1 Explanatory vs exploratory designs

The conceptual framework outlines that the interest of this study is to test relationships between different variables in order to evaluate the suitability of the envelope paradigm framework in the new HTSME context. Therefore, this study falls under the categorisation of explanatory studies rather than descriptive studies (Singleton and Straits, 2005). Explanatory studies seek to explain the relationships between variables. The particular focus of this study lies in the relationships between ownership and location variables with different types of FDI. In comparison, a descriptive approach would concern the isolated collection of the variables (Singleton and Straits, 2005). Hence, the explanatory approach is more suitable to the underlying research project.

5.3.2 Quantitative vs qualitative designs

This explanatory approach is also in line with Van de Ven's (2007) variance study, which is closely linked to quantitative research design. In contrast, a process study concerns the evolution of an idea during a research project. Hence, it is rather connected with a qualitative research design adopted to contribute to theory development. Thus, a process study would address 'how questions' through long-term investigation (Van de Ven, 2007). However, this study is interested with 'what questions', which is common in a variance study (e.g. What type of O and L-advantages determine the FDI of HTSMEs?). Therefore, the variance study approach is more suitable for this study. It allows for the statistical explanation of variation of the output factors (dependent variables) through evaluation of the input factors (explanatory variables) (Van de Ven, 2007). The decision for a variance study approach follows the reasoning that the research design and methods of a study should be guided by substantive research questions besides the methodological and epistemological considerations (Kelle, 2006).

The sections above provide several arguments why a variance study approach with a quantitative research design is more suitable in the underlying research context. As Jean Lee (1992:87) summarises "Quantitative and qualitative research are two different approaches, based on different paradigms and different assumptions about ontology and epistemology: two human phenomena rather than two different sets of research techniques. What research discovers and how it is discovered depends on how the researcher engages in the phenomena studied." The quantitative research approach is more objective than the qualitative approach (Easterby-Smith et al, 2002). It is concerned with the collection of numerical data, relies on statistical analysis and illustrates a deductive relationship between theory and data (Gill and Johnson, 2002; Jean Lee, 1992). In contrast, the qualitative approach is seen as more subjective. It builds on language and observations and implies an inductive relationship between data and theory (Sapsford and Jupp, 2006). Therefore, it constrains the researcher

to interpret phenomena occurring in the social world rather than using instruments that are seen as conclusive and feasible such as in quantitative research (Holliday, 2002). Table 5.1 provides an evaluation of both approaches.

Table 5.1 Quantitative vs qualitative research

	Quantitative research	Qualitative research
Aim	<ul style="list-style-type: none"> - to test theory by the measurement of causal relationships between variables - to derive general results from a larger sample population 	<ul style="list-style-type: none"> - to contribute to theory development through exploratory research on defined cases - to understand meanings attached to events and phenomena in the social world
Methods	<ul style="list-style-type: none"> - survey, experiment, quasi experiment 	<ul style="list-style-type: none"> - case study, grounded theory, action research, ethnography, narrative methods
Strengths	<ul style="list-style-type: none"> - deductive approach to test pre-determined hypotheses or concepts that make up theory - coverage of a wider population allowing for statistical analysis - standardised measurement for all participants through pre-tested constructs and items - emphasises objectivity, measurement, reliability, validity - reduced researcher bias through neutrality - data collection in a short specified time-frame 	<ul style="list-style-type: none"> - inductive approach to formulate theory - in-depth investigation of phenomena, allows the exploration of all possible phenomena concerning the research question - flexible approach allowing to account for emerging themes during the research process - less stringent methodological restrictions - emphasis on words, interaction and observation
Weaknesses	<ul style="list-style-type: none"> - deterministic and inflexible nature - phenomena can be too complex to be captured by the available empirical techniques - unable to account for upcoming context specific patterns during the data collection process - dependent on respondents' understanding and interpretation - single informant approach 	<ul style="list-style-type: none"> - reliant on the interpretation of the researcher - prone to researcher bias - not feasible for generalisation to a wider population - risk of distorted reality due to small sample sizes - higher financial and time efforts

Source: Developed by the author based on: Easterby-Smith et al (2002); Jean Lee (1992), Kelle (2006); Sapsford and Jupp (2006)

5.3.3 Cross sectional research design

Based on the above evaluation of explanatory vs descriptive study, variance vs process study and quantitative vs qualitative research approach, a cross sectional research design was adopted as it is the most suitable for studying the underlying research problem. The reason is that a cross sectional design allows to observe a larger HTSME population at a specific point in time (Oppenheim, 2000). In contrast, a longitudinal study would observe a smaller population of HTSMEs for a longer period (Easterby-Smith et al, 2012). Therefore, in light of the research aim and objectives, the cross sectional design is more suitable for this study. It has the advantage that a multitude of input variables (O and L-advantages) can be measured simultaneously. Moreover, it facilitates the measurement of the relationships between these factors and the output variable (Type of FDI). Thus, it provides answers to the research questions by generating quantifiable data and patterns of association between the observed variables (Bryman, 2004). Another advantage of adopting a cross-sectional design in this study is that related studies (e.g. Brouthers et al, 1996; Pinho, 2007) have adopted the same approach, which therefore enhances the comparability of the underlying findings with these studies.

Nevertheless, a quantitative cross sectional research design has drawbacks. First, it diminishes the flexibility of the research process due to the predetermined nature of defined research hypotheses. Thus, it sets a tight frame around the research agenda and does not account for emerging themes during the research process (Creswell, 2003). Second, it is possible that survey respondents answer differently because researchers try to control the situation and rely heavily on administering research instruments to the subject (Bryman, 2004). Third, the highly structured research approach building on instruments and procedures can influence and distort everyday life. For example, Oppenheim (2000) suggests that the measurement process of quantitative research is artificial and deceptive because the measures used to reflect relationships are developed and determined by social scientists, and

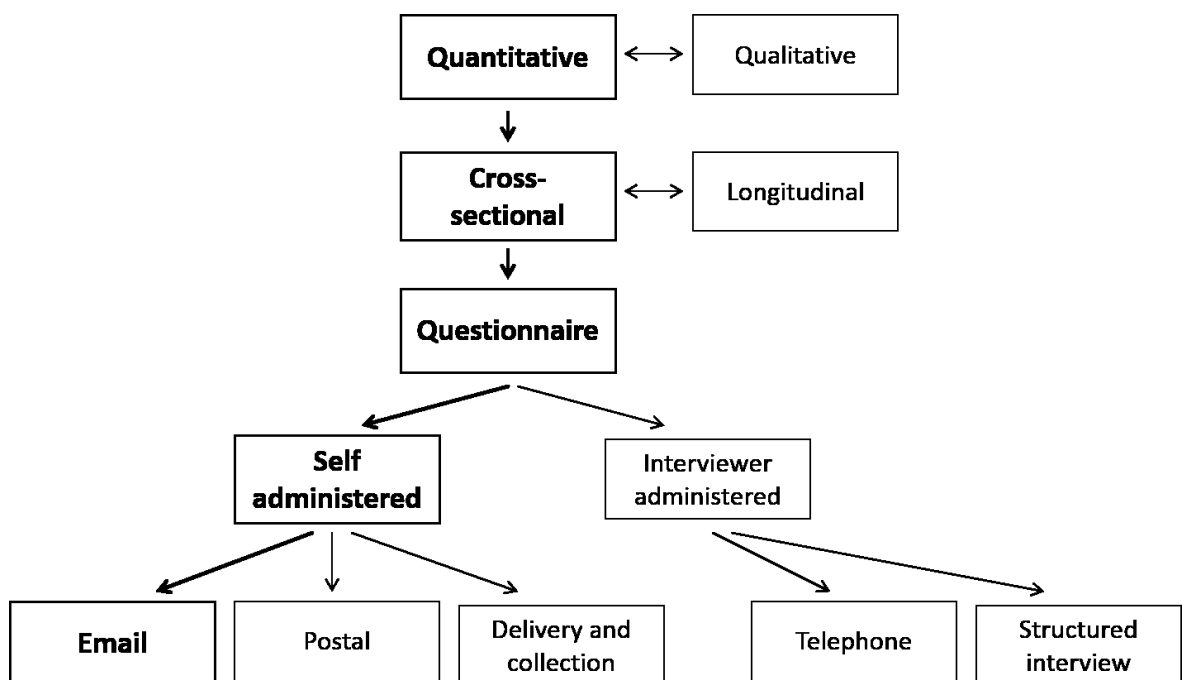
therefore not necessarily true. In order to address the possible drawbacks summarised above, a careful reliability and validity check of each measurement item will be performed. Furthermore, the study only adopts measurement items, which were used and validated in previous empirical research. This is a common procedure to reduce validity problems (Field, 2009).

5.4 Research method and instrument

5.4.1 Research method and data collection instrument

In accordance with the research design, the data collection method was quantitative and the data collection instrument was a self-administered survey questionnaire (see Figure 5.4).

Figure 5.4 Research instrument



Source: Adapted from Saunders et al (2003:282)
 Bold denotes the path followed in the present study

The self-administered email questionnaire is appropriate in this study for several reasons. The research followed a deductive logic as the adopted conceptual framework builds on existing theory. This facilitated the development of specific research hypotheses to inform

relationships between phenomena, which can be transformed into variables in order to facilitate statistical analysis (Cresswell, 2003). Accordingly, a quantitative survey design with close-ended questions seemed to be a more suitable systematic method for data collection than semi-structured interviews, case studies or observations (Blaikie, 2000). Furthermore, the quantitative research approach and subsequent statistical analysis allows generalising the research findings to a certain extent (Creswell, 2003). Therefore, this study adopted a cross-sectional research design. It permits the measurement of multiple factors simultaneously and is therefore the most suitable design to inform the research objectives and solve the underlying research problem. Moreover, it allows for the results of this study to be compared with similar related studies. In comparison, a longitudinal study is not in line with the research objectives of this study and is therefore less suitable.

Hence, a self-administered email survey questionnaire was adopted as it provides larger random responses and increased representativeness in comparison to an interviewer administered survey (Oppenheim, 1992). Additionally, it reduces socially desired answers in comparison to face-to-face or telephone interviews. Further practical advantages are the reduced costs in comparison to an interview schedule and the increased speed of data collection from random locally dispersed respondents (Sapsford and Jupp, 2006). The specific instrument adopted in this study was an email questionnaire. The particular advantages of an email questionnaire over a postal questionnaire or the delivery and collection method are the reduced time and cost factors. It does not require financial efforts for postage or travelling, printouts and envelopes. Furthermore, the email survey allows a more efficient administration of the filled in questionnaires as these can be automatically imported in a Microsoft Excel file and then transferred into the SPSS data analysis software. The manual transfer of data from a postal or delivery and collection questionnaire into an electronic file requires a considerably higher amount of time.

The specific format of the survey questionnaire was an interactive Pdf document, which was sent to a personalised email. The advantage of the interactive Pdf document is that respondents can return the filled in questionnaire to the researcher's official university email address by conveniently clicking one single button in the interactive document. The use of the official university email additionally enhances the credibility of the survey in comparison to online surveys using tools such as Survey Monkey. Furthermore, the easy response function of the interactive Pdf document reduces the likelihood of error in the submission process of the questionnaire (Heeringa et al, 2010). The interactive Pdf provides further convenience for the respondent due to its short and clear structure, and its interactive nature. Specifically the drop-down function for responses reduces length of the questionnaire and improves lucidity. This is supposed to have a positive impact on the response rate (Dillman et al, 2009).

Table 5.2 Evaluation of the email survey design

Advantages	Disadvantages
- Highly suitable to a deductive research approach	- Email might be seen as less official
- Targets a large sample population in geographically dispersed regions	- Email could be deleted or in the spam filter of the respondent
- Comparably high response rate	- Questions have to be short and easy to understand without losing relevant information
- Reduced financial costs	- Survey has to be short but still very precise in instructions
- Reduced time effort	- Does not allow to probe for further information
- Reduced bias error	- Reduced control if the targeted respondent has filled in the survey
- Greater anonymity	

Source: Developed by the author based on: Creswell (2003); Dillman et al (2009; 2011); Oppenheim (1992)

5.4.2 Sampling

This section discusses the sampling process by justifying the different steps leading to the final sample adopted in this study. It defines the unit of analysis, describes the sampling process in detail and justifies the key informant approach.

5.4.2.1 Unit of analysis

The unit of analysis in this study are the headquarters of German HTSMEs. Specifically, SMEs from the nanotech and biotech sector were chosen to represent the overall HTSME population for several reasons. First, in accordance with the definition of high-tech industries (see section 2.2), the nanotech and biotech industries are considered to be truly high-tech. Second, the vast majority of firms in these industries in Germany are SMEs (Federal Ministry of Education and Research, 2014a, 2014b). Third, nanotech and biotech SMEs are generally characterised through a high degree of internationalisation as their operations are organised within global networks (Mazzarol, 2007). Thus, nanotech and biotech SMEs can be viewed as highly representative for the HTSME population, which is significant for high population validity (Sapsford and Jupp, 2006). Fourth, the focus on headquarters is important as the study is interested in the relationships between ownership advantages embedded in the HTSMEs' headquarters and asset-exploiting and augmenting FDI activities. This additionally applies to the foreign location decision, made by the headquarters, and the FDI activities. Hence, the required information is obtained from the HTSMEs' headquarters rather than from the subsidiaries.

The general managers of the HTSMEs were identified as the key informant for the data collection. This is in line with common practice in empirical IB research (Haeusler et al, 2012; Schwens et al, 2011). By the virtue of their position, general managers are the most appropriate and feasible unit of analysis (Schwens et al, 2011). Targeting the general manager is an advantage of this study over studies of larger MNEs, which usually target

subsidiary managers. The reason is that given the size of a HTSME, the general manager is the only real decision maker about all issues in the home location as well as questions related to international activities and the foreign subsidiaries. Besides this, the structure of the survey questionnaire did not allow for multiple respondents. Nevertheless, it is acknowledged that the collection of data from a single respondent bears some risks. Critics argue it enhances the problem of common method variance (Chang et al, 2010). This issue will be discussed in more detail in section 6.2.3. Furthermore, Bowman and Ambrosini (1997) found that managers often lack consensus about strategic dimensions. However, in the specific case of this study, several questions concern factual information such as the adopted foreign market entry mode, the foreign location, the year of foreign entry etc. Other information are indeed very subjective such as e.g. the perceived importance of different foreign location advantages. However, in SMEs, the final decision on the foreign location is usually made by the general manager.

5.4.2.2 Sampling process

The sampling unit of the study were German nanotech and biotech SMEs that were not a subsidiary of any other firm. The sampling process commenced with the organisation of the sampling frame, which reflects the individual entities in the sampling unit (Sapsford and Jupp, 2006). The sampling frame of this study combines two census databases provided by the German Federal Ministry of Education and Research (BMBF)⁴. These are the largest official publically available databases of nanotech and biotech SMEs in Germany. In general, census-databases from governmental agencies are seen as reliable and accurate (Pinho, 2007). The first BMBF database was the ‘Nanotech’ database containing 842 nanotech SMEs. The second database was the ‘Biotech’ database containing 391 biotech

⁴ Nanotech census available at: http://www.nano-map.de/#hide_2

Biotech census available at: <http://www.biotechnologie.de/BIO/Navigation/DE/datenbank.html>

SMEs. The adoption of these databases has several advantages as they were developed by an official organisation and have been continuously maintained and updated. This enhances the reliability and accuracy of the obtained information from the databases. Furthermore, the databases include all nanotech and biotech firms of the population. This mitigates against non-coverage error (Dillman, 2011). This potential source of sampling error occurs when some firms of the targeted population are not represented in the sampling frame (Heeringa et al, 2010). The combined nanotech and biotech sample consisted of 1233 SMEs.

This census provided basic firm-specific information such as the firm's name, contact details, URL, and in some cases the headcount of employees. In order to advance the magnitude of relevant information, an extensive website search of each individual HTSME in the sample was undertaken by the researcher from April 2012 until August 2012. This included the extraction of the name of the general manager and if possible, the personal email address of the general manager in order to get direct access to the key informant. Furthermore, due to the extensive website search it was possible to extract information on the HTSMEs' engagement in any of the foreign activities under investigation in this study. Hence, the database was extended in most cases with information regarding the HTSME's possession of a foreign subsidiary or its engagement in joint ventures, partnerships, cooperations or export activities. In many cases it was possible to add the foreign location(s) of the international activities.

This further development of the database was a very extensive procedure that took intensive time and effort. The result of this extensive work was the creation of a state of the art tailor made census for a comprehensive survey research of the relevant HTSME population. Along the website search process, the census was revised according to a predetermined set of exclusion criteria. These criteria ensured that only firms relevant to the underlying research context remained in the sample. Firms were taken out if they were a consultancy or law firm

specialised in high-tech industries. Additionally, sole wholesalers of high-tech products were taken out. This ensured that only firms, which produce and sell their own high-tech products, remained in the census. Furthermore, firms were deselected if only a minor part of their operations concerned nanotech or biotech products. Finally, a few HTSMEs that have recently stopped trading were found. These HTSMEs were erased from the database as well as HTSMEs, which possessed a registered address, but were not actively trading. Thus, the results of this study are based on a census of all relevant HTSMEs. This represents a final size of 885 HTSMEs. This sample size is in line with other recent studies in the field⁵. Furthermore, when considering the available resources for the study, it is a manageable sample size (Sapsford and Jupp, 2006). The survey questionnaire was sent to all firms in the sample.

5.4.3 Maximising response rate

Several steps were taken in order to increase the response rate of the survey. First, the contact email (see Appendix A1) was personalised and addressed to the general manager of each HTSME as it is expected that personalisation contributes positively to the response rate (Dillman, 2011). As participation in a self-administered survey requires the motivation of the respondent (Jenkins and Dillman, 1997), the contact email was written in a way to trigger the HTSME's manager's interest by outlining that the research is of direct value for his/her firm (Sapsford and Jupp, 2006). Dillman (2011) consults social exchange theory in order to define three significant elements to increase survey responses: rewards, costs and trust. In order to account for these aspects, the contact email of the survey was clearly written to

⁵ For example: Alegre et al (2011) – 253 firms; Elango and Pattnaik (2007) – 794 firms; Galan et al (2007) – 585 firm; Johnson (2004) – 600 firms; Kenny and Fahy (2011) – 458 firms; Marsh and Stock (2006) – 494 firms; Musteen et al (2013) – 498 firms; Nummela et al (2004) – 493 firms; Pinho (2007) – 600 firms.

communicate the manager's benefits for participation, decrease the perceived efforts to be made and promote mutual trust.

Second, the contact email clearly outlined the objectives of the study. Thus, the general managers could see that the research investigates a very new and highly relevant topic for HTSMEs. It is expected that this step triggers the managers' interest followed by the desired action of responding (Dillman, 2011). The third step to increase the response rate was to offer the manager a comprehensive summary of the findings after completion (Harzing, 2000). As the asset-exploiting and asset-augmenting FDI activities are salient for HTSMEs, it is necessary for managers to engage in this topic. Therefore, a free summary of up-to-date empirical findings is supposed to be a major incentive for participation. The fourth step to increase the response rate was the use of follow-up emails to the non-respondents as suggested by Thomaskovic-Devey et al (1994). These reminders (Dillman, 2011) were sent in three waves every two weeks. Finally, all remaining non-respondents were personally called by the researcher in order to increase the capacity and motive of the HTSME managers to respond. These telephone reminders relied on the notion of reciprocity in a conversation meaning that respondents are more reluctant to deny participation in a direct interaction with the researcher (Thomaskovic-Devey et al, 1994).

The fifth step pertains to the problem of item non-response, which is a main source of error in surveys meaning that missing data items can result in the loss of usable responses (Heeringa et al, 2010). This issue was addressed through immediate visual follow-up checks of each returned questionnaire. In case data entry error or missing data was discovered, the respondent was contacted via email or telephone and asked to revise the affected question/s again. Thus, the few cases where the non-response problem occurred could be solved with the primary source of information so that missing data techniques such as multiple imputation (Rubin, 1987) were not required.

5.4.4 Questionnaire construction and question design

5.4.4.1 Questionnaire validity

The questionnaire design is crucially important as it determines the accuracy of the responses (Brace, 2013). A deficient survey design would lead to the systematic bias of respondents in the interpretation and response of survey questions (Heeringa et al, 2010). Therefore, this section describes the development of the survey questions and summarises the adopted procedures to account for their validity. Sapsford and Jupp (2006) suggest that survey questions should be developed under the criteria of being unambiguous and easy to read. Therefore, the survey questions were formulated as short as possible without risking the loss of any relevant information (Brace, 2013). According to Dillman (2011), this reduces the possibility of measurement error as understandable questions contribute to correct answers. Most questions focused on a key concept representing HTSME ownership factors or host/home location factor. The wording and layout of the questions was discussed with the researcher's supervisory team, internal and external academics and practitioners following the question design approach outlined by Dillman (2011). This mitigates the possibility of measurement error, which is a result of poor wording and sentence structure, and results in inaccurate or imprecise responses (Dillman, 2011).

Questions concerning O and L-advantages are closed questions with self-reported measures. This is a commonly adopted approach in international business and strategic management research (Presutti et al, 2007). Nevertheless, it is acknowledged that self-reported measures might bear the risk that results are seen as showing consistent perceptions of managers rather than the actual O and L-advantages. The advantage of self-reported measures is their efficiency in eliciting responses from managers rather than requesting direct answers (Tomaskovic-Devey et al, 1994). Makino et al (2002:414) highlight "Although there is the danger of self-reporting bias, research has found that perceived measures were correlated positively with objective measures." Responses to the self-reported measures were provided

on a seven-point Likert scale. This type of measurement involves a series of scale items (Hair et al, 2006). It is easy to accomplish and has been very commonly adopted in international business research (see Alegre et al, 2011; Davis and Meyer, 2004; Han and Celly, 2008; Luk et al, 2008; Marsh and Stock, 2006; Schwens et al, 2011). The Likert type measurement procedure is standardised and therefore ensures that gathered information is comparable and meaningful statistics can be produced (Brace, 2013). Nevertheless, critics claim that a shortcoming of Likert scale items is the problem of reproducibility. It occurs when an identical score can be obtained in several ways (Singleton and Straits, 2005). This shortcoming was addressed through the adoption of multi-item constructs in some cases to measure O or L-advantages (Brace, 2013).

5.4.4.2 Measurement items

The measurement items for the questions were adopted from previous related studies in the field (Dillmann, 2011). The advantage is that items have already been piloted, applied and verified in previous empirical studies (Easterby-Smith et al., 2002). Hence, the development of new survey items was avoided in order to circumvent validity problems as suggested by Creswell (2003). This adoption of existing survey items is a widespread procedure in international business research (Dimitratos et al., 2012). The specific selection process of the measurement items was in accordance with the selection guidelines described by DeVellis (2003). Thus, it was ensured that the adopted measurement items convey what the researcher claims (Sapsford and Jupp, 2006). This process will be discussed in more detail in section 5.5 ‘operationalisation of key variables’.

5.4.4.3 Structure and translation of the questionnaire

The original questionnaire was composed in English as the adopted key constructs were derived from international business literature published in English. As the sample only

consists of German HTSMEs, the questionnaire was consequently translated into German and then back translated in English following common standards. This ensured equivalence between the two versions and is a common procedure in international business studies (Chen et al, 2009). Furthermore, in order to ensure high quality translation, the translation process was conducted in collaboration with the PhD supervisory team and two native speaking German business professors. Along this process, the face validity of the questionnaire was tested and resulted in several minor changes (Dillman, 2011). The final questionnaire consisted of 2.5 pages (see Appendix A1).

The questionnaire is structured in five sub-sections in order to enhance lucidity, look and 'easy to answer format' (Dillman, 2011). Each of the five sub-sections groups questions according to a specific point of interest. Thus, the respondent could complete the questionnaire without being confused due to constantly switching points of interests (Dillman, 2011). However, the order of the sub-sections was random so that the respondent could not follow the logic of the overall argument. This change of the sequencing of the sections also reduces common method bias, as Likert type questions were split and asked in different parts of the questionnaire (common methods bias will be discussed in detail in section 6.2.3). For example, the section concerning the home country disadvantages was placed between the sections obtaining information on the HTSME's O-advantages and the host country L-advantages.

The questionnaire was structured as followed: The first section addressed non-threatening and easy to answer questions as suggested by Dillman (2011) to gather information about the foreign activities of the HTSMEs. This concerned the HTSMEs' basic information for classification such as firm age and size etc. The second section of the questionnaire addressed the foreign activities and foreign location of the HTSME. The third section gathered information related to the HTSME's O-advantages and the asset-exploiting and

asset-augmenting abilities. The fourth section concerned the location disadvantages in the HTSMEs' home country (Germany) with respect to innovative activities. Finally, the fifth section gathered information on the L-advantages in the HTSMEs' host country and asset-exploiting and asset-augmenting activities.

5.4.5 Pilot study

Pre-testing a questionnaire enhances validity and reliability, and identifies possible error sources (Brace, 2013). Therefore, the questionnaire was piloted in August and September 2012 following the common practice in survey research (Dillman, 2011). The pilot was a trial containing five face-to-face assessment sessions (each lasted around 45 minutes) with general managers of HTSMEs, a representative sample of the target population (Sapsford and Jupp, 2006). The pilot interviews were designed to test the clarity of instructions, completion time and general feasibility of the questionnaire as suggested by Oppenheim (2000). Furthermore, the feedback of the general managers facilitated improvements of the questionnaire layout as it has been acknowledged that design matters impact the response rate (Sapsford and Jupp, 2006). The pilot feedback was used to refine the wording of the questions in order to enhance their appropriateness in the underlying HTSME context. Due to the precise comments of the managers in the first two pilot interviews, some minor changes of the wording of some questions were made. The remaining three pilot respondents confirmed the clarity of the questions in the following interviews. No question was identified as 'sensitive' by the respondents. This should reduce the non-response bias (Heeringa et al, 2010).

However, the feedback after the first two pilot interviews initiated changes regarding the structure of the questionnaire. For example: Question 2.1 initially asked for mode of entry and sought to lead the respondent from there to the following associated question related to the chosen mode of entry. Instructions said "If you have selected 'Subsidiary' or 'Joint

venture with equity’ in Question 2.1, please continue with question 2.2. If you have selected ‘Joint Venture without equity’, please continue with Question 3.1. If you have selected ‘Partnership’, please continue...” etc. Pilot respondents disclosed that the instructions were too long and confusing as managers appreciate short straight forward surveys, which do not require jumping between different sections. In response to the feedback, the guiding instructions following question 2.1 were taken out. Instead, the first sentence of each following section commenced with a clear instruction such as “Only answer if you chose in question 2.1 ‘subsidiary or equity joint venture’.” Thus, managers could go through the questions in a consecutive manner following short and clear instructions. The general managers interviewed in pilots four and five confirmed the appropriateness of this new structure and suggested no further changes.

Another change resulting from the pilot feedback was the division of the home and host-country location factors in two separate sections. The pilot draft of the questionnaire organised factors representing the home country disadvantage and host country advantage as a combined set in Section 4. However, based on the feedback of the pilot respondents, these two sets were split and organised in two individual sections. The newly structured questionnaire organised factors representing home country disadvantages were placed under the header ‘Innovation in Germany’ in Section 4. Factors representing location and host country advantages in Section 5 were placed under the header ‘The foreign location factors’. The respondents in the final pilot sessions confirmed this structure as clearly understandable. Furthermore, all pilot respondents did not outline any sensitivity problems with the survey questions, which could have occurred as a source of non-response bias (Dillman, 2011).

5.4.6 Data collection process

In order to improve the effectiveness of the data collection process, the researcher engaged in a structured research exchange with a host university in Germany, the country under investigation in this study. In particular, the researcher stayed for three months at the Viadrina University in Frankfurt (Oder) to conduct the study. As this research exchange was part of an official IB cooperation between the two universities, the researcher received an office space, a German university email address and telephone number and support from a secretary. Furthermore, the researcher received extensive support of two business professors who functioned as host supervisors. This included regular structured meetings to review the questionnaire, translate the questionnaire, refine the contact email and to organise and coordinate the different steps of the data collection process. The location of the researcher in a legitimised partner located in the study country was supposed to increase mutual trust with the respondents and to increase the response rate of the survey (Harzing, 2000; Thomaskovic-Devey et al, 1994). The email survey was sent from the researcher's official host university email account and contained the university's logo, its official address and telephone number. Furthermore, reminders were sent in three waves every two weeks to non-respondents in order to enhance the response rate. Finally, non-respondents were called from the host university landline in order to convince them to participate in the study (Dillman, 2011). The two host professors provided their contact details in case a potential respondent asked for further verification of the study from a higher ranked academic. This is supposed to enhance credibility of the study and to delineate its magnitude.

5.5 Operationalisation of key variables

This section provides the definitions and operationalisation of the variables adopted in this study. Section 5.5.1 presents the dependent variable, section 5.5.2 outlines the explanatory variables and section 5.5.3 elaborates on the control variables.

5.5.1 Dependent variable: Type of FDI

As discussed in the theoretical framework chapter, this study distinguishes between the asset-augmenting and asset-exploiting FDI of HTSMEs. Therefore, the dependent variable is termed *Type of FDI*. It is a dichotomous variable taking the value 1 if the HTSME undertakes asset-augmenting FDI, and 0 if the HTSME undertakes asset-exploiting FDI. In particular, following the operationalisation of Iwasa and Odagiri (2004), the label 0 was attributed to HTSMEs reporting that their subsidiary performs asset-exploiting activities defined as:

- Adaptive R&D
- Production
- Marketing & Sales
- Logistics & Distribution
- Other Activities

The label 1 was attributed to HTSMEs reporting that their subsidiary performs asset-augmenting activities defined as:

- R&D for New Product Development

As Iwasa and Odagiri (2004:813) highlight, this categorisation underlies the assumption that “An R&D subsidiary refers to a subsidiary performing R&D and not necessarily a subsidiary established for the purpose of R&D. For instance, it may be an R&D department attached to plants.” This definition is important in the underlying context as HTSME subsidiaries often perform several of the activities listed above simultaneously. The reasoning is the incremental nature of the subsidiaries’ evolutionary process, which usually commences with

sales activities and continuously integrates higher degrees of product development and advanced R&D activities (see Abidi et al, 2011 and Blomqvist et al, 2010). Furthermore, subsidiary activities such sales and advanced R&D are often conducted by the same highly educated scientists due to the considerable explanation-intensive nature of the products and the high complexity of the mutual exchange with customers and suppliers (De Maeseneire and Claeys, 2012). Therefore, a possible limitation of Iwasa and Odagiri's (2004) operationalisation is that it categorises subsidiaries, which only perform a very small amount of R&D for new product development as asset-augmenting subsidiaries. In order to overcome this possible drawback, this study only categorised FDI as asset-augmenting type when the subsidiary reported that a share $\geq 25\%$ of its activities concerned R&D for new product development (see Appendix A1, Section 2.3). This 25% threshold has been applied in previous studies as a cut-off point to demarcate subsidiary activities (Uhlenbruck, 2004) and subsidiary performance (Morrison and Roth, 1992).

Table 5.3 Operationalisation of the dependent variable

Variable	Measured as	Source	Measurement scale	Empirical foundations
<i>Type of FDI</i>	Share of employees ($\geq 25\%$) in R&D for new product development	Iwasa and Odagiri (2004)	1 = asset-augmenting 0 = asset-exploiting	Ambos and Reitsperger, 2004; Assmussen et al, 2009; Criscuolo, 2005; Davis and Meyer, 2004; Frost et al, 2002; Jensen and Pedersen, 2011; Hogenbirk and Kranenburg, 2006; Lewin, 2009; Schmiele, 2012

5.5.2 Independent variables of interest

The following sections provide the operationalisation of the explanatory variables, which are the predictors of the effect being studied (Oppenheim, 2000). The explanatory variables in this study are specified by building on the theoretical guidelines of the envelope paradigm framework, specifically the ownership and location sub-paradigms (as outlined in the

theoretical framework, Figure 4.1). The research seeks to measure the effect of O and L-advantages on the FDI of German HTSMEs with a specific focus on asset-exploiting and asset-augmenting activities. The adopted measures are informed by the extensive international business literature.

5.5.2.1 O-advantages related to asset-exploiting FDI

This section provides the operationalisation of the O-advantages that are expected to be positively related to the asset-exploiting FDI of HTSMEs (see hypotheses 1a-e). These advantages are: *Product Differentiation*, *Technology Adaptation*, *Ability to Develop Patents*, *Support of Foreign Production/Sales* and *Scale Economies* (see questionnaire in Appendix A1). The items were measured on a seven point Likert-scale ranging from 1 (none) to 7 (very high).

The HTSME's *Ability to Develop Differentiated Products* provides a significant advantage as it reduces the competition in the home and host market (Galan and Gonzales-Benito, 2006; Majeed et al, 2011; Oerlemans and Meeus, 2005). To secure this advantage, the HTSME does not share its specific knowledge with a foreign partner and rather internalises foreign operations through FDI (Nakos and Brouthers, 2002; Pinho, 2007). Hence, following previous empirical research adopting the OLI framework (Brouthers et al, 1996, 1999; Nakos and Brouthers, 2002; Wrona and Trapczynski, 2012), this study adopted the *Product Differentiation* measure from Aggarwal and Ramashwami's (1992) seminal study. Managers were asked to evaluate the ability of their firm to develop differentiated products (see Appendix A1, Section 3.4).

The *Ability to Adapt Firm-specific Technology* to the foreign market is an advantage the HTSME seeks to protect through high control entry modes such as FDI (Dunning, 1993). As

international customers require diversified technological solutions, asset-exploiting HTSMEs need to possess higher abilities to adapt technology to local customer requirements (Brouthers et al, 1996; Kuemmerle, 1999a). The operationalisation of *Technology Adaptation* was adapted from Rammer and Schmiele's (2008) measure and adjusted to the underlying research context. Managers were asked to evaluate the ability of their firm to adapt firm-specific technology to foreign markets (see Appendix A1, Section 3.4).

The HTSME's *Ability to Develop Patents* allows it to protect intellectual property against competitors (Almeida and Phene, 2004; Coeurderoy and Murray, 2008; Haeusler et al, 2012). Thus, it facilitates the foreign exploitation of the firm-specific advantages without being exposed to the risk of losing knowledge (Haeusler et al, 2012; VonHippel, 1988). This study adapted Rammer and Schmiele's (2008) operationalisation of the measure by adjusting the wording of the question to the specific context of this study. Managers were asked to evaluate the ability of their firm to develop patents (see Appendix A1, Section 3.4).

Due to the complexity of high-tech products, HTSME should possess an *Internal Support Structure* that provides the subsidiary specialised process know-how (Arvanitis and Hollenstein, 2011). HTSMEs can protect this know-how from partners or sub-contractors by engaging in high control entry modes (Li et al, 2011; Pinho, 2007). The operationalisation of the variable was adopted from Arvanitis and Hollenstein (2007, 2011). Managers were asked to evaluate the ability of the headquarters to support foreign production and sales (see Appendix A1, Section 3.4).

Scale economies is a widely used concept in IB research to explain FDI motivation (Chidlow et al, 2009; Majeed et al, 2011). It can enable the HTSME's internationalisation through the exploitation of existing scale advantages and it can leverage further scale advantages through further foreign market expansion (Coeurderoy and Murray, 2008; Filatotchev et al, 2011). This study adopted the *Scale Economies* measure operationalisation of Galan and Gonzales-

Benito (2006). Managers were asked to evaluate the ability of their firm to reduce the costs of production for large volumes (see Appendix A1, Section 3.4).

Table 5.4 Operationalisation of the variables related to O-exploiting FDI

Variable	Measured as	Source	Measurement scale	Empirical foundations
<i>Product Differentiation</i>	Ability to develop differentiated products	Adopted from Aggarwal and Ramashwami (1992)	Likert-scale from 1 (none) to 7 (very high)	Liu and Buck, 2007; Luk et al, 2008; Phene and Almeida, 2008; Pinho, 2007; Singh, 2008; Wrona and Trapczynski, 2012; Zheng et al, 2012
<i>Technology Adaptation</i>	Ability to adapt firm-specific technology to foreign markets	Adapted from Rammer and Schmiele (2008)	Likert-scale from 1 (none) to 7 (very high)	Arvanitis and Hollenstein, 2007, 2011; Frost, 2001; Hatem, 2011; Luk et al, 2008; Makino et al, 2002; Rammer and Schmiele, 2008
<i>Patent Development</i>	Ability to develop patents	Adapted from Rammer and Schmiele (2008)	Likert-scale from 1 (none) to 7 (very high)	Alegre et al, 2011; Arvanitis and Hollenstein, 2007; Iwasa and Odagiri, 2004; Li et al, 2011; Liu and Buck, 2007
<i>Internal Support Structure</i>	Ability to support foreign production and sales	Arvanitis and Hollenstein (2011)	Likert-scale from 1 (none) to 7 (very high)	Arvanitis and Hollenstein, 2007, 2011; Hollenstein, 2009; Luk et al, 2008; Makino et al, 2002; Rammer and Schmiele, 2008
<i>Scale Economies</i>	Ability to reduce unit costs through large production volumes	Galan and Gonzales-Benito (2006)	Likert-scale from 1 (none) to 7 (very high)	Boddewyn and Lundan, 2009; Chidlow et al, 2009; Galan and Gonzales-Benito, 2006; Pinho, 2007; Saarenketo et al, 2004

5.5.2.2 O-advantages related to asset-augmenting FDI

This section provides the operationalisation of the O-advantages that are expected to be positively related to the asset-augmenting FDI of HTSMEs (see hypotheses H2a-e). These advantages are: *Innovative capability*, *R&D Network*, *Absorptive Capacity*, *Internal Knowledge Network* and *Foreign Knowledge Implementation* (see questionnaire in Appendix A1). The items were measured in percent, on a Likert-scale ranging from 1 (none) to 7 (very high) and a Likert-scale from 1 (strongly disagree) to 7 (strongly agree).

The *Innovative Capability* of the HTSME facilitates its FDI activities as innovative high-tech firms seek to exploit and explore their competitive advantages in international markets (Coeurderoy and Murray, 2008; Fernhaber et al, 2009; Li et al, 2011). Particularly, the amount of employees related to R&D activities has been outlined as fundamental for the innovative capability of high-tech firms (Al-Laham et al, 2011; Melen and Nordman, 2009). This study adopted the operationalisation of Haeusler et al (2012). Managers were asked to indicate the share of employees (in %) directly or indirectly associated with R&D activities in the headquarters (see Appendix A1, Section 3.2).

The *R&D Network* of the HTSME has a supportive effect on its foreign asset-augmentation (Arvanitis and Hollenstein, 2011, Baum et al, 2001; Li et al, 2011; Haeusler et al, 2012). Some studies operationalised the variable by counting the R&D cooperations with external actors (Chang, 2003; Oerlemans and Meeus, 2005). However, using the count of R&D cooperation might be misleading in this study due to high differences in firm size in the sample. A HTSME with 20 employees might perceive five R&D cooperations as a lot, while a HTSME with 200 employees might perceive it as little. Therefore, this study adopted Sternberg and Arndt's (2001) operationalisation of the measure by asking managers to evaluate the extent of R&D cooperations their firm was engaged in within the last three years (see Appendix A1, Section 3.3).

The effect of a firm's *Absorptive Capacity* on its asset-augmenting FDI activities has been widely acknowledged in IB literature (Ambos et al, 2006; Gupta and Govindarajan, 2000; Phene and Almeida, 2008; Makino et al, 2002). This study adopted a construct developed by Mahnke et al (2005) to operationalise the *Absorptive Capacity* measure. Managers were asked to state their agreement to the following two statements: (1) We perfectly understand the knowledge accessed abroad. (2) We can easily acquire the new knowledge accessed

abroad (see Appendix A1, Section 3.5). The construct's Cronbach's alpha value of .849 lies above the suggested threshold (Pallant, 2007).

Several studies suggested that the *Internal Knowledge Network* of the firm has an impact on its asset-augmenting FDI activities (Criscuolo and Narula, 2007; Frost et al, 2002; Hollenstein, 2009). The extent of the augmenting FDI depends on the degree to which firm internal entities share competences and knowledge (Frost et al, 2002; Phene and Almeida, 2008). For the operationalisation of the measure, this study adapted a construct from Arvanitis and Hollenstein (2011) and Mahnke et al (2005) to the context of the underlying research. Managers were asked to state their agreement to the following two statements: (1) The knowledge of the German headquarters is transferred to the foreign subsidiary. (2) The knowledge of the foreign subsidiary is transferred to the German headquarters (see Appendix A1, Section 3.6). The construct's Cronbach's alpha value of .659 lies within the accepted range for studies with short scales (scales with fewer than 10 items), as it is the case in the underlying study (Pallant, 2007).

The *Foreign Knowledge Implementation* informs the input and importance of the foreign sourced knowledge for the HTSMEs innovation process (Oerlemans and Meeus, 2005; Phene and Almeida, 2008). It follows the notion that a higher ability to implement the foreign sourced knowledge in the innovation process increases its engagement in asset-augmenting FDI (Frost et al, 2002; rammer and Schmiele, 2008). This study adopted the operationalisation of Oerlemans and Meeus (2005) by slightly changing the wording of the question. Managers were asked to state their agreement to the following statement: The knowledge sourced abroad is important for the development of our products and patents (see Appendix A1, Section 3.7).

Table 5.5 Operationalisation of variables related to O-augmenting FDI

Variable	Measured as	Source	Measurement scale	Empirical foundations
<i>Innovative Capability</i>	Share of R&D employees in the HQ	Adapted from Haeusler et al (2012)	Percent	Haeusler et al, 2012; Kumar, 2007; Lee and Rugman, 2011; Liu and Buck, 2007; Sher and Yang, 2005
<i>R&D Network</i>	Extent of R&D cooperations	Adopted from Sternberg and Arndt (2001)	Likert-scale from 1 (none) to 7 (very high)	Arvanitis and Hollenstein, 2007, 2011; Ganotakis and Love, 2011; Kenny and Fahy, 2011; Li et al, 2011; Love and Ganotakis, 2013
<i>Absorptive Capacity</i>	(1) Ability to understand and (2) Acquire the foreign knowledge	Adopted from Mahnke et al (2005)	Likert-scale from 1 (strongly disagree) to 7 (strongly agree)	Liu and Buck, 2007; Mahnke et al, 2005; Makino et al, 2002; Phene and Almeida, 2008; Saarenketo et al, 2004
<i>Internal Knowledge Network</i>	(1) Knowledge transfer HQ to subsidiary and (2) Knowledge transfer subsidiary to HQ	Adapted from Arvanitis and Hollenstein (2011); Mahnke et al (2005)	Likert-scale from 1 (strongly disagree) to 7 (strongly agree)	Alegre et al, 2011; Criscuolo, 2009; Frost et al, 2002; Hollenstein, 2009; Mahnke et al, 2005; Phene and Almeida, 2008
<i>Foreign Knowledge Implementation</i>	Importance of foreign knowledge for the development of products and patents	Adapted from Oerlemans and Meeus (2005)	Likert-scale from 1 (strongly disagree) to 7 (strongly agree)	Arvanitis and Hollenstein, 2011; Frost, 2001; Frost et al, 2002; Phene and Almeida, 2008; Rammer and Schmiele, 2008; Singh, 2008

5.5.2.3 L-advantages related to asset-exploiting FDI

This section provides the operationalisation of the L-advantages that are expected to be positively related to asset-exploiting FDI (see hypotheses 3a-b). These advantages are: *Cost Factors* and *Market Factors* (see questionnaire in Appendix A1). The items were measured on a seven point Likert-scale ranging from 1 (not important at all) to 7 (very important).

Cost Factors have been widely used in IB studies to explain the FDI motivation related to foreign asset-exploitation (Chidlow et al, 2009; Galan et al, 2007; Buckley and Casson, 2009). In knowledge intensive industries, the relevant cost factors relate to the increased efficiency in production costs and adaptive R&D costs by accessing cheaper skilled labour

(Hatem, 2011; Hollenstein, 2009; Rammer and Schmiele, 2008; Qu et al, 2013). This study adopted Arvanitis and Hollenstein's (2011) operationalisation of the measure. Managers were asked to evaluate cost factors (such as lower production costs, lower R&D costs) regarding their importance on the foreign activity (see Appendix A1, Section 5.1).

The interdependence between *Market Factors* and FDI has been one of the most widely acknowledged relationships in IB research (Flores and Aguilera, 2007). Most survey based studies measure market attractiveness as perceived managerial assessment of market factors (Aggarwal and Ramanshwami, 1992; Brouthers et al, 1996; Brouthers et al, 1999; Galan et al, 2007; Galan and Gonzales-Benito, 2006; Nakos and Brouthers, 2002; Pinho, 2007). Following these studies, this study adopted the operationalisation of Pinho (2007) and asked managers to evaluate market factors (such as market size and market growth potential) regarding their importance on foreign activities (see Appendix A1, Section 5.1).

Table 5.6 Operationalisation of variables related to L-exploiting FDI

Variable	Measured as	Source	Measurement scale	Empirical foundations
<i>Cost Factors</i>	Lower adaptive R&D and production costs	Arvanitis and Hollenstein (2011)	Likert-scale from 1 (not important at all) to 7 (very important)	Arvanitis and Hollenstein, 2011; Chidlow et al, 2009; Galan et al, 2007; Hilber and Voicu, 2010; Lewin et al, 2009; Hollenstein, 2009
<i>Market Factors</i>	Attractiveness of foreign market size and demand	Pinho (2007)	Likert-scale from 1 (not important at all) to 7 (very important)	Chidlow et al, 2009; Coeurderoy and Murray, 2008; Galan et al, 2007; Narula and Santangelo, 2012; Pinho, 2007; Wrona and Trapczynski, 2012

5.5.2.4 L-advantages related to asset-augmenting FDI

This section provides the operationalisation of the L-advantages that are expected to be positively related to asset-augmenting FDI (see hypotheses 4a-e). These are: *Institutional Environment*, *Abundance of Highly Skilled Human Capital*, *Proximity to Scientific Institutions and Innovative Firms*, *Proximity to Innovative Suppliers*, *Proximity to Industrial*

Concentrations and Home Country Disadvantage (see questionnaire in Appendix A1). The items were measured on a seven point Likert-scale ranging from 1 (not important at all) to 7 (very important).

The *Institutional Environment* of the host country impacts on the FDI streams to this country (Davis and Meyer, 2004; Hollenstein, 2009). In the context of high-tech industries, it specifically concerns governmental regulations (red tape) to innovation activities and the enforcement of intellectual property protection in a country (Coerderoy and Murray, 2008; Narula and Santangelo, 2012; Rammer and Schmiele, 2008). Therefore, the *Institutional Environment* measure in this study is operationalised as a two-item construct adopted from Fagerberg and Srholec (2008). Managers were asked to state the importance of the following two location factors for their foreign activity: (1) Low governmental regulations (red tape) to innovation activities. (2) Intellectual property protection (see Appendix A1, Section 5.1). The construct's Cronbach's alpha value of .668 lies within the accepted range for studies with short scales (scales with fewer than 10 items), as it is the case in the underlying study (Pallant, 2007).

The *Abundance of Highly Skilled Human Capital* has a significant impact on the firm's engagement in asset-augmenting FDI in a host country (Hatem, 2011; Lewin et al, 2009). It is a key success factor for firms that seek to tap into new knowledge pools and to take advantage of technological opportunities abroad (Arvanitis and Hollenstein, 2011; Frost et al, 2002; Sternberg and Arndt, 2001). This study adopted the operationalisation of the measure from Arvanitis and Hollenstein (2011). Managers were asked to evaluate the importance of getting access to highly skilled employees directly or indirectly involved in R&D for their foreign activity (see Appendix A1, Section 5.1).

The *Proximity to Scientific Institutions and Innovative Firms* is an important driver for firms to undertake asset-augmenting FDI in a particular location (Arvanitis and Hollenstein, 2011,

Hatem, 2012; Narula and Santangelo, 2012). Being close to public and private research institutes and innovative industry related firms allows the HTSMEs to take advantage of knowledge spillovers (Cantwell and Piscitello, 2005; Hollenstein, 2009; Phene and Almeida, 2008). This study adapted the operationalisation of the measure from Arvanitis and Hollenstein (2011) and Hollenstein (2009) by applying a two-item construct. The wording was slightly altered to fit the underlying context. Managers were asked to state the importance of the following two location factors for their foreign activity: (1) Proximity to leading universities and public and private research institutes. (2) Proximity to innovative firms (see Appendix A1, Section 5.1). The Cronbach's alpha of the construct was .789 and therefore above the suggested threshold (Pallant, 2007).

The firm's *Proximity to Innovative Suppliers* enables the provision of specialised inputs and is therefore an important driver for its engagement in asset-augmenting FDI in a specific location (Cantwell and Piscitello, 2005; Hollenstein, 2009; Oerlemans and Meeus, 2005). Hence, the establishment of a close relationship with technologically advanced suppliers enables the HTSME to develop an advanced technological base for further product development (Arvanitis and Hollenstein, 2011). This study adapted the operationalisation of the measure proposed by Hollenstein (2009) by altering the wording of the question to fit the underlying context. Managers were asked to evaluate the importance of proximity to innovative suppliers for their foreign activity (see Appendix A1, Section 5.1).

The firm's *Proximity to Industrial Concentrations* is a key factor for its engagement in asset-augmenting FDI in a specific country (Kedron and Bagchi-Sen, 2012; Narula and Santangelo, 2012). The investing firm can take advantage of industrial agglomerations and co-location effects in the host country (Hatem, 2011; Hilber and Voicu, 2010). This study operationalised the *Proximity to Clusters* variable by adopting the specific measurement of Galan and Gonzales-Benito (2006) and Galan et al (2007). Managers were asked to evaluate

the importance of a high industrial concentration (such as industrial parks and technological networks) for their foreign activity (see Appendix A1, Section 5.1).

The *Home Country Disadvantage* in relation to innovative activities has been identified as key motivation for firms to undertake innovative activities in a host country that is more conducive to radical innovation (Arvanitis and Hollenstein, 2011; Hollenstein, 2005, 2009; Kampik and Dachs, 2011; Rammer and Schmiele, 2008). The measure has been commonly operationalised as a combined construct consisting of several location factors related to the disadvantage of the home country. This study adopted the operationalisation of Arvanitis and Hollenstein (2011) and Rammer and Schmiele (2008) applying a four item construct. Managers were asked to state their agreement to the following statements: (1) There is a lack of highly skilled R&D employees in Germany. (2) There is a lack of demand for innovative products in Germany. (3) Innovation costs are high in Germany. (4) Government regulations and red tape are high in Germany (see Appendix A1, Section 4.1). The Cronbach's alpha value of the construct lies with .711 above the suggested threshold (Pallant, 2007).

Table 5.7 Operationalisation of variables related to L-augmenting FDI

Variable	Measured as	Source	Measurement scale	Empirical foundations
<i>Institutional Environment</i>	(1) Importance of low governmental regulations and (2) Intellectual property protection	Adopted from Fagerberg and Srholec (2008)	Likert-scale from 1 (not important at all) to 7 (very important)	Davis and Meyer, 2004; Hollenstein, 2009; Narula and Santangelo, 2012; Rammer and Schmiele, 2008; Galan et al, 2007; Ito and Wakasugi, 2007; Wrona and Trapczynski, 2012; Zhao, 2006
<i>Abundance of Highly Skilled Human Capital</i>	Access to skilled R&D labour	Adapted from Arvanitis and Hollenstein (2011)	Likert-scale from 1 (not important at all) to 7 (very important)	Davis and Meyer, 2004; Hatem, 2011; Hollenstein, 2005, 2009; Narula and Santangelo, 2012; Rammer and Schmiele, 2008; Zhou et al, 2002
<i>Proximity to Scientific Institutions &</i>	(1) Proximity to leading scientific institutions	Adapted from Arvanitis and	Likert-scale from 1 (not important at	Ambos, 2005; Chidlow et al, 2009; Davis and Meyer, 2004; Frost et al, 2002; Hatem, 2011; Hollenstein,

<i>Innovative Firms</i>	and (2) Proximity to innovative firms	Hollenstein (2011)	all) to 7 (very important)	2009; Narula and Santangelo, 2012; Sternberg and Arndt, 2001
<i>Proximity to Innovative Suppliers</i>	Proximity to innovative suppliers	Adapted from Hollenstein (2009)	Likert-scale from 1 (not important at all) to 7 (very important)	Cantwell and Piscitello, 2005; Davis and Meyer, 2004; Frost et al, 2002; Galan and Gonzales-Benito, 2006; Galan et al, 2007; Hatem, 2011; Hollenstein, 2009; Narula and Santangelo, 2012
<i>Proximity to Industrial Concentrations</i>	Proximity to industrial concentration	Adopted from Galan et al (2007)	Likert-scale from 1 (not important at all) to 7 (very important)	Galan and Gonzales-Benito, 2006; Galan et al, 2007; Hatem, 2011; Hilber and Voicu, 2010; Narula and Santangelo, 2012
<i>Home Country Disadvantage</i>	(1) Lack of R&D employees, (2) Lack of demand for innov. prod, (3) High innov. costs, (4) High gov. regulations	Adopted from Arvanitis and Hollenstein (2011) and Rammer and Schmieie (2008)	Likert-scale from 1 (strongly disagree) to 7 (strongly agree)	Arvanitis and Hollenstein, 2007; Davis and Meyer, 2004; Fagerberg and Srholec, 2008; Hatem, 2011; Hollenstein, 2009; Kampik and Dachs, 2011; Rammer and Schmieie, 2008; Sternberg and Arndt, 2001

5.5.2.5 Control variables

The study included control variables to check if other factors than the explanatory variables have an effect on the FDI of HTSMEs. Thus, it is controlled if the relationships between the dependent and independent variables are by chance (Kerr et al., 2002) in order to enhance the reliability of this study (Miles and Shevlin, 2001). The control variables are: *Age*, *Size*, *International Experience* and *Industry* as previous research suggests that these variables affect the FDI activities of the firm.

The *Age* of the HTSME is considered to impact on the scope and nature of the FDI as different activities in the foreign subsidiary require capabilities and competencies that are developed and accumulated over time (Arvanitis and Hollenstein, 2011; Ito and Wakasugi, 2007; Musteen et al, 2013; Schmieie, 2012). Hence, this study controlled whether the age of the HTSME has an impact on the type of FDI it engages in. The *Age* measure was adopted

from Schmiele (2012). Managers were asked to indicate the year of establishment of the firm (see Appendix A1, Section 1.1).

The *Size* of the HTSME influences the type of FDI undertaken by the firm as it has been found that size is associated with the scope of the foreign activities (Arvanitis and Hollenstein, 2011; Schmiele, 2012; Schwens et al, 2011). This study adopted the *Size* measure from Schwens et al (2011). Managers were asked to indicate the count of the HTSME's full-time employees worldwide (see Appendix A1, Section 1.2).

The *International Experience* measure was included as increasing foreign experience is associated with an increasing engagement in different types of FDI (Arvanitis and Hollenstein, 2007; Kuemmerle, 1999a; Nakos and Brouthers, 2002; Schmiele, 2012). This study adopted the *International Experience* measure from Nakos and Brouthers (2002). Managers were asked to indicate the number of years their business has been operating abroad (see Appendix A1, Section 1.3).

A dummy *Industry* variable was included to control if the industry (nanotech / biotech) of the HTSME affects the type of FDI. The operationalisation of Chang (2003) and OECD definitions of nanotech and biotech industries was applied in the census databases provided by the German Federal Ministry of Education and Research. Firms in the nanotech industry were labelled 1, and firms in the biotech industry were labelled 0.

Table 5.8 Operationalisation of control variables

Variable	Measured as	Source	Measurement scale	Empirical foundations
<i>Age</i>	Number of years since establishment	Adopted from Schmiele (2012)	In years	Arvanitis and Hollenstein, 2011; Filatotchev et al, 2011; Ito and Wakasugi, 2007; Li et al, 2011; Musteen et al, 2013; Parida et al, 2012
<i>Size</i>	Number of employees in the firm worldwide	Adopted from	Headcount of employees	Arvanitis and Hollenstein, 2011; Musteen et al, 2013; Parida et al, 2012; Qu et al, 2013; Schwens et al, 2011

		Schmiele (2012)		
<i>International Experience</i>	Number of years the firm operates abroad	Adopted from Nakos and Brouthers (2002)	In years	Iwasa and Odagiri, 2004; Musteen et al, 2013; Pinho, 2007; Rammer and Schmiele, 2008; Schwens et al, 2011; Wrona and Trapczynski, 2012
<i>Industry</i>	Nanotech and biotech	Adopted from Chang (2003)	1 = nanotech 0 = biotech	Andersson et al, 2002; Chidlow et al, 2009; Haeusler et al, 2012 McDonald et al, 2008; Schwens et al, 2011

5.5.2.6 Foreign location variable

Finally, the questionnaire asked for the *Location* of the HTSME's foreign activity. This variable was not part of the regression analysis but received particular attention in a separate analysis due to its significance in the underlying research context. Building on the implications of the national innovation systems literature (Hall and Soskice, 2001), this study is interested in the attractiveness of liberal market economies for the FDI of HTSMEs from coordinated market economies such as Germany. The operationalisation of the location variable was adopted from Makino et al (2002) by asking the managers to report on their most representative foreign activity (see Appendix A1, Section 2.2). The *Location* variable is a categorical variable with the nominal values Western Europe, Central and Eastern Europe, USA, Great Britain, China, India, Japan & other Asia-Pacific, others. This specific categorisation of countries/regions was developed to meet the specific criteria of internationalised HTSMEs from Germany. This development procedure of the variable was in line with other studies in the field following the same approach (Arvanitis and Hollenstein, 2011; Ficarek and Veloso, 2010; Galan and Gonzales-Benito, 2006; Galan et al, 2007; Jensen and Pedersen, 2011).

5.6 Response analysis

5.6.1 Response rate

The full sample in this study consisted of 885 HTSMEs. The email survey including the three waves of email reminders and the final telephone reminder generated 204 useable responses, which equal a response rate of 23.0% (see Table 5.9). This response rate is in line with the average of similar studies in the field (see Brouthers, 2013; Ellram et al, 2013; Galan et al, 2007; Ganotakis and Love, 2011; Parida, 2012; Schwens et al, 2011). This response rate is adequate, as it has to be acknowledged that previous research concluded that in the specific research context of Germany the response rates are generally lower than in other countries (Gammelgaard et al, 2012; Schwens and Kabst, 2009). Moreover, lower response rates can be expected in quasi-voluntary survey studies conducted by universities in Western Europe (Heeringa et al, 2010) and when general managers are targeted (Harzing and Noorderhaven, 2006). Both aspects were fulfilled in the underlying study. Therefore, the achieved response rate is considered as reasonable.

Table 5.9 Response rate

	Nanotech	Biotech	Total
Sample	567	318	885
Responses	138	66	204
Response rate	24.3%	20.8%	23.0%

5.6.2 Pre-estimation tests: Representativeness and non-response bias

Several steps were undertaken to test for representativeness and non-response bias as suggested by Heeringa et al (2010). Chi-square tests were employed to check if respondents and non-respondents differ according to key characteristics such as industry and HQ location (West Germany / East Germany). The required data for non-respondents was generated through the nanotech and biotech databases, which were introduced during the sampling process (see section 5.4.2.2). The results of the chi-square tests showed no significant differences for industry (chi-square 1.442; sig. 0.230) and HQ location (chi-square 0.058;

sig. 0.809). This means that respondents and non-respondents do not show statistical differences in terms of key characteristics. Therefore, the obtained sample is an adequate representation of the HTSME population and allows to generalise the empirical findings of this study to the HTSME population (Hair et al, 2009).

Furthermore, chi-square tests were conducted to check for differences between early and late respondents (Heeringa et al, 2010). This is an important procedure as three waves of reminders and a follow up phone call to the non-respondents were conducted during the data collection process. The tests between early and late respondents showed no difference between HTSME *Age* (Chi-square 0.902; sig. 0.342), HTSME *Size* (Chi-square 1.927; sig. 0.165) and *Industry* (Chi-square 2.318; sig. 0.128).

The results of the pre-estimation tests discussed above were verified by a wave analysis, which compared the accumulated responses between the different survey waves according to the HTSME's *Age*, *Size* and *Industry*. Table 5.10 outlines that, apart from *Size* in wave 1 and 2 vs wave 3, there are no severe differences between the responses of the different waves.

Table 5.10 Wave analysis

	Wave 1 vs wave 2			Wave 1 and 2 vs wave 3			Wave 1,2, and 3 vs wave 4		
	<i>Industry</i> ⁶	<i>Age</i> ⁷	<i>Size</i> ⁸	<i>Industry</i>	<i>Age</i>	<i>Size</i>	<i>Industry</i>	<i>Age</i>	<i>Size</i>
Chi square value	.393	.786	.007	1.376	.321	3.136	.011	.472	.123
Sig.	.531	.375	.933	.242	.571	.007	.917	.492	.726

In summary, the conducted tests evaluating the differences between non-respondents and respondents did not show significant differences. Therefore, the null hypothesis of

⁶ Industry was divided into nanotech and biotech

⁷ Age was calculated through a median split of the sample

⁸ Size was calculated through a median split of the sample

significant differences could not be rejected. This means that the obtained data for this study does not contain a significant extent of non-response bias.

5.7 Statistical instrument for hypothesis testing

Due to the nature of the data and the dichotomous categorical dependent variable *Type of FDI* (asset-exploiting / asset-augmenting), binary logistic regression was determined as the regression technique for this study (Field, 2009; Hosmer et al, 2013). The binary logistic regression has been proven as a suitable analysis technique in related research fields examining SMEs, FDI and innovation (see e.g. Majeed et al, 2011; Schwens et al, 2011; Teixeira and Heyuan, 2012; Wu and Lin, 2010). Thus, strong empirical and theoretical evidence indicates that a logistic regression analysis is appropriate for this study. The conventional ordinary least square (OLS) regression analysis is not suitable for this study as it is only an appropriate technique when the research problem leads to a metric dependent variable (Field, 2009). By adopting OLS regression, researchers could gain more detailed information about the dependent variable (Tavares and Young, 2006). However, the OLS estimators, which possess desirable statistical properties, do not hold these properties when applied in a model with a dichotomous outcome variable (Hosmer et al, 2013). Therefore, OLS regression analysis seems unsuitable for this study.

In a similar vein, structural equation modelling is not suitable for the underlying study. As Hair et al (2009) suggest, structural equation modelling requires strict data alignment to the characteristics of a study. This makes an adoption of this technique unsuitable in many cases. The partial least square (PLS) analysis (as a specific structural equation modelling technique) has previously been preferred over OLS regression when the independent variables show high levels of multicollinearity, or when there is many dependent variables. However, this study is neither affected by high multicollinearity (as discussed later in section 6.2.4.4), nor does it include many outcome variables. Moreover, Hair et al (2009) suggest

that structural equation modelling techniques are most useful in exploratory studies with a weak theoretical foundation. However, the theoretical and conceptual part of this study is built on the envelope paradigm framework, which is deeply anchored in theoretical and empirical literature in the field (Buckley and Hashai, 2009). The operationalisation of concepts is guided by established theory and therefore, structural equation techniques do not suit the nature of this study.

Therefore, given the binary nature of the dependent variable in this study, the most suitable analysis technique is binary logistic regression. It allows investigating the odds ratio of the probability of an event occurring in one group to the odds of the event occurring in another group. In this process, “The logistic regression model takes the natural logarithm of the odds as a regression function of the predictors (LaValley, 2008:2395).” For example, in case of 1 predictor (X) it becomes:

$$\ln[\text{odds}(Y=1)] = \beta_0 + \beta_1 X$$

In this function, ‘ln’ is the natural logarithm, Y is the outcome value with Y=1 meaning the event occurs and Y=0 the event does not occur, β_0 is the intercept term while β_1 is the regression coefficient, which shows the change of the logarithm of the odds when the predictor X has a one unit change (LaValley, 2008).

The full logistic regression model predicts an event Y (dependent variable) occurring (Y=1). In comparison to OLS regression, the produced logistic regression model is non-linear. Therefore, the logistic regression equations used to describe the outcome are somewhat more complex than multiple regression equations (Tabachnick and Fidell, 2007). The classical logistic regression equation is:

$$P(Y) = \frac{1}{1 + e^{-(b_0 + b_1 X_{1i} + b_2 X_{2i} + \dots + b_n X_{ni})}}$$

In this equation, $P(Y)$ denotes the probability of Y occurring and e denotes the base of the natural logarithms. The b_0 value is the constant, intercept or logit $P(Y)$ value when $X_j = 0$. The b_j value is the weight assigned to the explanatory variables, which are indicated by X_j (Field, 2009).

5.8 Summary

This chapter discussed the research methodology adopted in this study. It commenced with a discussion of different ontological and epistemological positions and a justification why scientific realism is the most suitable position in the underlying research context. The subsequent section discussed the research design and determined a quantitative survey design. Then, the following sections developed the data collection instrument, discussed the sampling process and the response rate. This was followed by the operationalisation and justification of the measurement constructs for the empirical investigation. The subsequent section provided an analysis of the response characteristics and pre-estimation tests. Finally, the last section introduced and discussed the logistic regression analysis technique to analyse the regression models. The results of the regression models will be discussed in the next chapter.

6 Data analysis and results

6.1 Introduction

This chapter presents the findings of the statistical analysis of the proposed research hypotheses. The first part of this chapter elaborates on the data transformation and analysis containing missing values, pre-tests, common method bias and a post-estimation analysis (sections 6.2). The section 6.3 presents descriptive statistics and a univariate analysis to answer research questions 1 and 2. Section 6.4 presents the regression models and results to answer research questions 3, 4 and 5. This contains a presentation of the overall model statistics, results of the research hypotheses and two summary tables of the results. Finally, section 6.5 provides a summary of the chapter.

6.2 Data transformation and analysis

6.2.1 Missing values

The problem of missing data occurs when a respondent fails to answer one or more questionnaire items (Hair et al, 2009). In this study, six out of the 204 survey responses were incomplete. As every response email was checked for missing data immediately after receipt, it was possible to promptly establish contact (via phone or email) with the HTSME managers who participated and gather the missing information. Thus, this study did not suffer from missing data and was not required to adopt specific imputation techniques to account for missing data (Hair et al, 2009).

6.2.2 Pre tests

The application of statistical analysis requires several pre-tests before the commencement of the actual analysis. Although logistic regression does not underlie as stringent data requirements as OLS analysis (Hair et al, 2009), it was still important to check several assumptions prior to the analysis (Field, 2009; Pallant, 2007). Hence, pre-tests were

conducted to check for sample size, normality, outliers and multicollinearity. Furthermore, it was checked for common method bias.

6.2.2.1 Sample size

There were 204 survey responses. Out of these 204 HTSMEs, 68 HTSMEs engaged in FDI, 117 HTSMEs engaged in non-equity entry modes and 19 HTSMEs solely operated domestically. The first part of the subsequent data analysis involved comparing the characteristics of different types of HTSMEs using descriptive analysis techniques for all 204 cases. The second part of the data analysis testing the FDI activities of HTSMEs with logistic regression models includes the 68 cases of HTSMEs with FDI. The logistic regression models consist of between two to six predictor variables. Hence, each model has 11.33 or above cases per explanatory variables. Hair et al (2009) suggest a minimum of five observations per explanatory variable to avoid unstable results. Therefore, the ratio of observations per predictor variables is well above the minimum threshold.

6.2.2.2 Normality

Logistic regression does not specifically require testing and transformation to meet the normality assumption. However, normality allows more stable regression solutions (Hair et al, 2009). Therefore, the independent variables were tested for normality of sampling distribution in two ways. First, histograms and p-p plots were examined visually. Second, a statistical Kolmogorov-Smirnov test was conducted (Field, 2009). If necessary, variables were transformed using the log or square root transformations following Pallant (2007) and Field (2009). The specific transformations are summarised in Appendix C1.

6.2.2.3 Outliers

Outliers are observations that substantially differ from the other observations in the sample (Hair et al, 2009). It is important to identify outliers as they can bias the statistical analysis (Field, 2009). Hence, several steps were undertaken in order to check for outliers.

First, it was checked for possible data entry error (Pallant, 2007). Second, influential univariate and bivariate outliers were identified through the examination of histograms, boxplots and scatterplots in SPSS (Field, 2009; Hair et al, 2009). Within this process, a few outliers were identified. Some authors suggest to remove these extreme cases from the sample, while other scholars advise to adjust the values of the outliers in order to reduce their impact (Field, 2009; Tabachnick and Fidell, 2007). This study followed the latter option in order to avoid a reduction of the already limited sample size by deleting critical cases. Instead, the scores of the outliers were altered following a specific procedure described by Field (2009:153), which is summarised in Appendix C2. Third, several diagnostic tests were conducted to check if specific cases exert undue influence on parameters in the models as suggested by Field (2009) and Hair et al (2009) (see Appendix C3). The tests were supposed to reveal if the regression models are stable over the sample or if influential observations bias the results (Field, 2009). Therefore, three types of residuals were examined: standardised, studentised and studentised deleted. Furthermore, it was checked how certain cases influence the models as a whole by adopting Cook's distance, leverage (hat values) and Mahalanobis distance. Finally, the standardised version of the DFFit values and the covariance ratio were checked. The threshold values for these diagnostics were calculated following the equations provided by Field (2009:217). The results of the diagnostic tests showed that the O-exploiting model and L-exploiting model were not affected by any influential cases. However, the tests revealed critical cases that constantly failed to pass the thresholds for the Control model, O-augmenting model and L-augmenting model. Accordingly, one influential case in each of these models was deleted and the regressions

were rerun. The new results showed remarkable changes in the significance values of some variables.

6.2.2.4 Multicollinearity

The variables adopted in the regression analysis were checked for high intercorrelation, also known as multicollinearity (Field, 2009). It occurs when explanatory variables are correlated and therefore possess a higher degree of shared variance. This affects the individual explanatory variable in a way that its unique variance decreases (Hair et al, 2006). In order to account for this problem, several tests for multicollinearity were conducted. First, the correlation matrix was visually inspected for high correlation-coefficients (above .9) to get an indication of multicollinearity (Hair et al, 2009). The dependent, independent and control variables were correlated in order to check the bivariate relationships between the transformed variables. As the correlation matrix (see Appendix C4) outlines, the highest correlation-coefficient is 0.711, which is well below the critical threshold of 0.9 (Hair et al, 2009).

Nevertheless, Field's (2009) claim has to be noted that scanning the correlation matrix is only a good starting point for multicollinearity checks. However, it is not sufficient to investigate multicollinearity (Field, 2009). Therefore, a second test round was conducted to check the variance inflation factors (VIF) and condition index values as suggested by Hair et al (2006). The VIF reveals if an independent variable has a strong linear relationship with any other independent variable (Field, 2009). It is the inverse of $1-R^2$ where R^2 is calculated by regressing the independent variables against each other. The resulting VIF shows the increase in variance of an explanatory variable due to collinearity. Hair et al (2006) suggest a VIF above 5 as critical. The calculated VIFs for the estimates in this study ranged from 1.015 - 2.650 (see Appendix C5 for a summary of all VIFs). The highest condition index value was 23.137, which is below the suggested threshold of 30. Furthermore, the variables

in the condition indexes did not exceed the threshold value of 0.9 in more than one coefficient (Hair et al, 2006). Therefore, multicollinearity should not have a major impact on the subsequent regression analysis.

6.2.3 Common method bias

Chang et al (2010) suggest that systematic measurement error can lead to common method bias (CMB). They define CMB as the “variance that is attributable to the measurement method rather than to the constructs the measures represent. It creates a false internal consistency, that is, an apparent correlation among variables generated by their common source” (Chang et al, 2010:178). A commonly suggested approach to mitigate CMB is to obtain data from multiple respondents in one entity (Schwarz et al, 2008). However, this study has followed a single informant approach for several valid reasons as discussed in section 5.4.2.1. Therefore, following common practice in IB research, several additional ex-ante and ex-post methods were conducted to counteract possible problems related to CMB (Chang et al, 2010; Li et al, 2013).

First, the questionnaire was designed in a way that the respondents could not draw conclusions on the underlying hypotheses based on emerging questionnaire patterns. Thus, it was possible to avoid socially desired responses (Heeringa et al, 2010). Second, the measurement types between different measurement items was altered and placed in different sections in the questionnaire, which reduced the likelihood of CMB (Harrison et al, 1996). Third, if applicable, measurement constructs were adopted instead of single measurement items as Schwarz et al (2008) suggests that CMB is more likely to occur at single item level. Fourth, the key informant approach adopted in this study targeted general managers as respondent. This ensured that the respondents have direct experience with the measurement constructs (the O and L-advantages of the firm). A lack of this experience would otherwise enhance CMB (Harrison et al, 1996). Fifth, the dependent variable (Type of FDI) and some

independent variables (size, age, share R&D employees etc.) were objective measures rather than cognitions. Thus, other sources were used to validate the obtained data from the HTSME managers, which was a great advantage to reduce CMB. Sixth, the correlation matrix (see Appendix C4) confirmed the expectation that CMB should not be a serious concern in this study as the variables did not show alarmingly high correlations.

Finally, in order to ascertain that the obtained data is not influenced by CMB, three ex-post statistical approaches were conducted: A Harman's single factor test, a marker-variable analysis and a triangulation using archival sources (Chen et al, 2009; Ertrug et al, 2013). The Harman single factor test is an unrotated factor analysis requiring all items adopted in the study in one exploratory factor analysis. It suggests that if CMB is present, a single or general factor accounting for a very high variance between the items will emerge (Podsakoff et al, 2003). The results of the Harman's test revealed nine factors with an eigenvalue greater than one, which together accounted for 72.05% of the variance. The largest factor only explained 19.677% of the variance. These findings did not imply severe problems with CMB (Ertug et al, 2013).

Another recommended remedy to test for CMB is a marker variable analysis (Lindell and Whitney, 2001). Its application requires the inclusion of a further variable that is theoretically unrelated to the focal variables included in the statistical analysis. Therefore, this study included the variable *Share of Academics*⁹ as the marker variable as it is supposed to be unrelated to the substantive variables in this study (see section 2.3). The results of the partial correlation adjustment revealed 4 out of 55 significant relationships became non-significant. This is a further indicator for the absence of CMB in this study (Lindell and Whitney, 2001). The final remedy for CMB checked for triangulation by using data, which was partly provided by the adopted database of the Federal Ministry (BMBF). The

⁹ Measured as share of academics in percent

questionnaire responses for the measures HTSME age and number of employees were compared with the secondary data obtained directly from the BMBF database. Both sources showed 100% consistency for the gathered information in the survey questionnaire. Therefore, it is very unlikely that this study is affected by CMB.

6.2.4 Post-estimation analysis

A random split sample technique as suggested by Hair et al (2009) was conducted in order to validate the underlying results and to check for miss specifications and robustness of the models (see Appendix C6). This included the rerun of the regression models with a randomly split sample. It has to be noted that due to the reduced sample size and the underlying limitations entailed by the degrees of freedom, it was only possible in some split sample models to include the significant variables from the full sample analyses. The regression results of the split sample models resembled the original models. Therefore, the results of the split sample technique validated the models.

6.3 Descriptive statistics and univariate analysis

The following sections provide the results related to the Research Questions 1 and 2. Non-parametric tests were conducted to test for differences in terms of HTSME age, size, international experience, industry and host country. Furthermore, frequency tables are presented to provide further insights. The descriptive statistics outline number of cases, missing cases, minimum, maximum, mean and standard deviation (see Appendix B1).

6.3.1 Comparison of firm characteristics between HTSMEs with FDI and non-equity entry

This section provides the descriptive statistics to answer the questions formulated under research question 1.

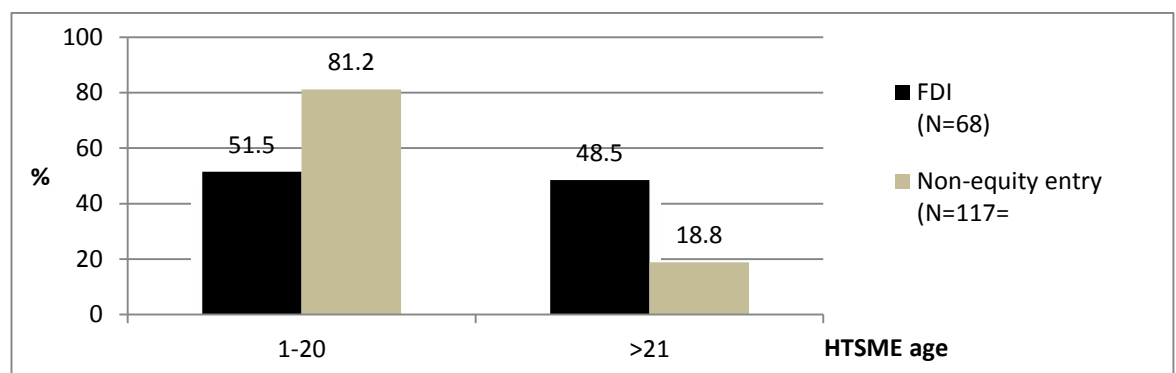
To what extent do HTSMEs undertake FDI and non-equity entry modes?

The analysis of all HTSMEs in the sample revealed that 68 firms (33.33%) have undertaken FDI. Another 117 HTSMEs (57.36%) were engaged in non-equity entry modes and 19 HTSMEs (9.31%) were not internationalised. This means that more than 90% of the German nanotech and biotech HTSMEs are internationalised. Looking at these internationalised HTSMEs only, the results outline that 36.76% of the firms engage in FDI and 63.24% engage in non-equity entry modes to foreign markets.

How do firm characteristics differ between HTSMEs that undertake FDI and HTSMEs that engage in non-equity entry modes?

Firm Age: A Chi-Square Test revealed a significant difference for the age of HTSMEs that engage in FDI and HTSMEs that engage in non-equity entry modes. It showed that older HTSMEs are more likely to engage in FDI. As Figure 6.1 summarises, 48.5% of the HTSMEs that engage in FDI are older than 20 years. In comparison, less than 18.8% of the HTSMEs with non-equity entry are older than 20 years.

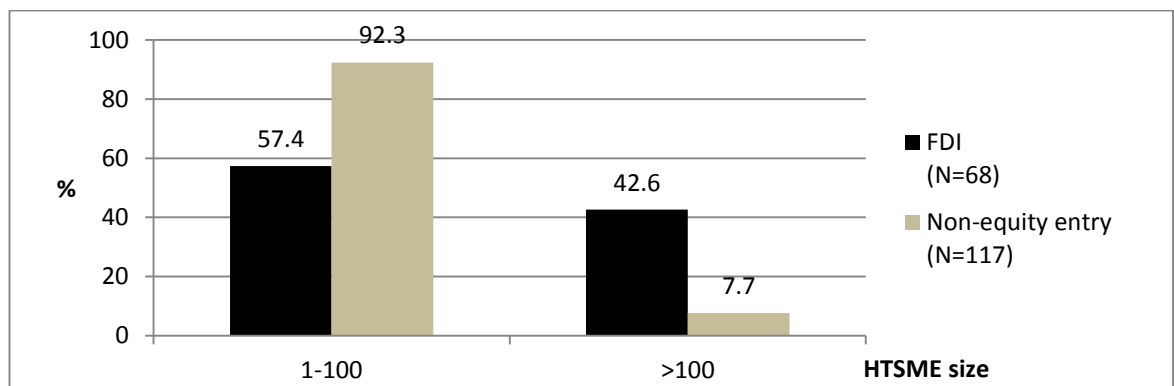
Figure 6.1 Entry mode in relation to the age of the HTSME



Chi-Square: $\chi^2 (1, N = 185) = 18.190, p = .000, \phi = .031$.

Firm size (headcount of employees): A Chi-Square Test revealed a significant difference in the size of the HTSMEs with FDI and non-equity entry. This implies that larger firms are more likely to engage in FDI. Figure 6.2 outlines that the 42.6% of the HTSMEs that engage in FDI employ more than 100 employees while only 7.7% of the HTSMEs that engage in non-equity entry modes employ more than 100 employees.

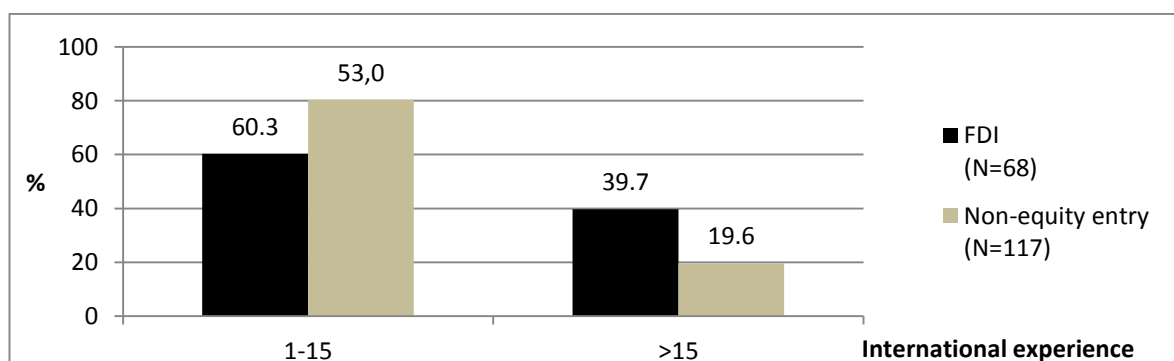
Figure 6.2 Entry mode in relation to the size of the HTSME



Chi-Square: $\chi^2 (1, N = 185) = 32.194, p = .000, \phi = .042$

International experience (years operating abroad): A Chi-Square Test showed a significant difference between HTSMEs that engage in FDI and HTSMEs that engage in non-equity entry modes. This implies that HTSMEs with greater international experience are more likely to engage in FDI. Figure 6.3 visualises this finding, showing that 39.7% of the HTSMEs with FDI have more than 15 years international experience. In comparison, 19.6% of the firms with non-equity entry have more than 15 years of international experience.

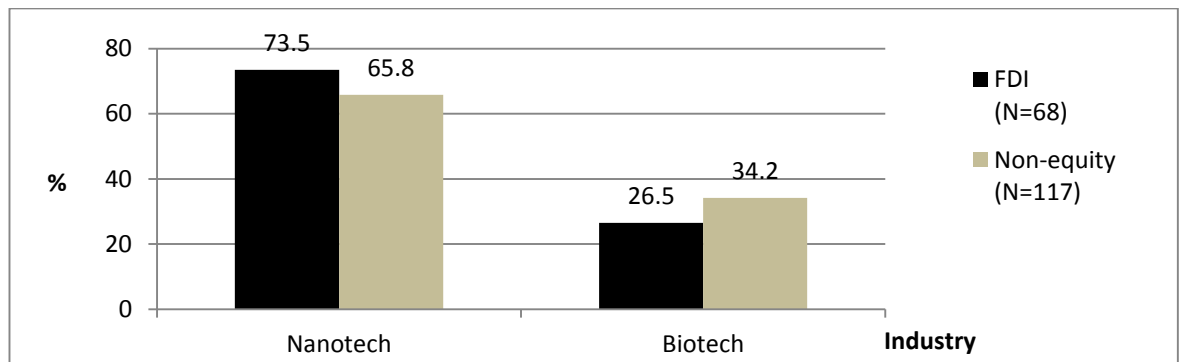
Figure 6.3 Entry mode in relation to the HTSME's international experience



Chi-Square: $\chi^2 (1, N = 185) = 8.764, p = .003, \phi = .022$

Industry: A Chi-Square Test indicated no significant association between industry and entry mode, $\chi^2 (1, N = 185) = .859, p = .354, \phi = .080$. Figure 6.4 outlines that the proportion of the allocation of the firms between the two industries is similar for HTSMEs with FDI and HTSMEs with non-equity entry.

Figure 6.4 Entry mode in relation to industry

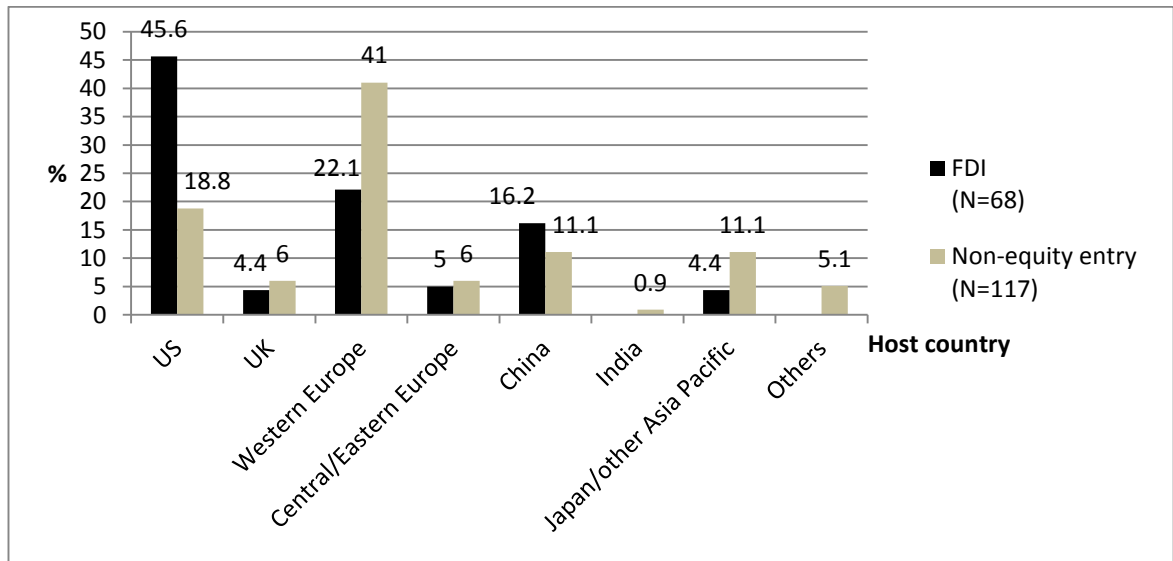


Chi-Square: $\chi^2 (1, N = 185) = .859, p = .354, \phi = .080$

In which countries/regions do HTSMEs undertake FDI?

A Chi-Square Test was applied to investigate if there is an association between HTSMEs with FDI and the market entry into liberal market economies. The US and UK were defined as liberal market economies while the remaining host countries were defined as non-liberal market economies (following the varieties of capitalism framework by Hall and Soskice, 2001). The Chi-Square Test showed that there is a significant association between HTSMEs with FDI and entry in liberal market economies. Figure 6.5 visualises the frequencies of FDI and non-equity entry into the different countries/regions. It shows that FDI is the predominant entry mode for the US, while for the remaining countries non-equity entry is the preferred choice.

Figure 6.5 Entry mode in relation to the host country



Chi-Square: $\chi^2 (1, N = 185) = 11.077, p = .001, \phi = .257$.

Summary of the findings related to the differences in firm characteristics between HTSMEs with FDI and HTSMEs with non-equity entry:

- HTSMEs with FDI are significantly older than HTSMEs with non-equity entry.
- HTSMEs with FDI are significantly larger than HTSMEs with non-equity entry.
- HTSMEs with FDI have significantly more international experience than HTSMEs with non-equity entry.
- The industry affiliation of HTSMEs with FDI does not differ to HTSMEs with non-equity entry.
- HTSMEs with FDI invest significantly more in host countries that are characterised as liberal market economies.

6.3.2 Comparison of firm characteristics between asset-exploiting and asset-augmenting HTSMEs

This section provides the descriptive statistics and univariate tests to answer the questions formulated under research question 2.

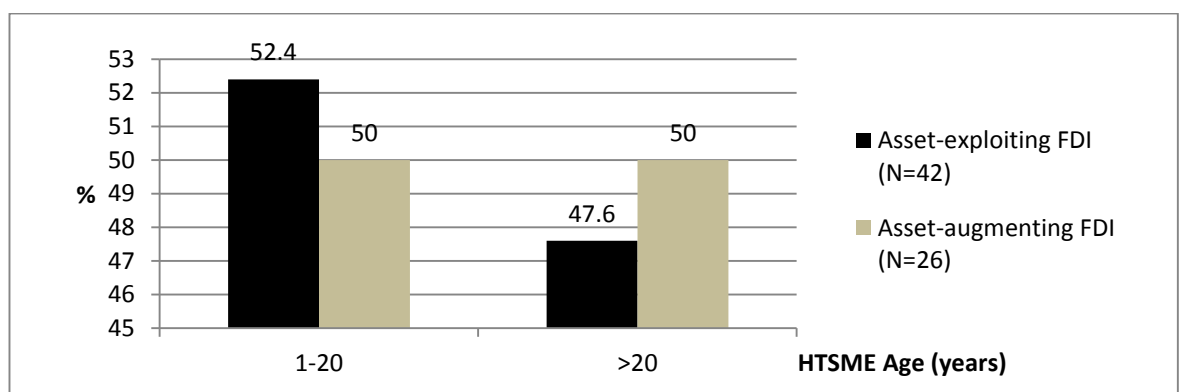
What is the extent of asset-exploiting and asset-augmenting FDI of HTSMEs?

Of the 68 HTSMEs in the sample that have undertaken FDI, 38.2% engaged in asset-augmenting FDI. Accordingly, 61.8% of the HTSMEs have undertaken asset-exploiting FDI.

How do firm characteristics differ between HTSMEs that undertake asset-exploiting FDI and HTSMEs that engage in asset-augmenting FDI?

Firm age: A Chi-Square Test indicated no significant association between age and type of FDI (exploiting or augmenting). Figure 6.6 visualises that there is almost no difference in the allocation of asset-exploiting and asset-augmenting HTSMEs among the age groups.

Figure 6.6 Type of FDI in relation to HTSME age

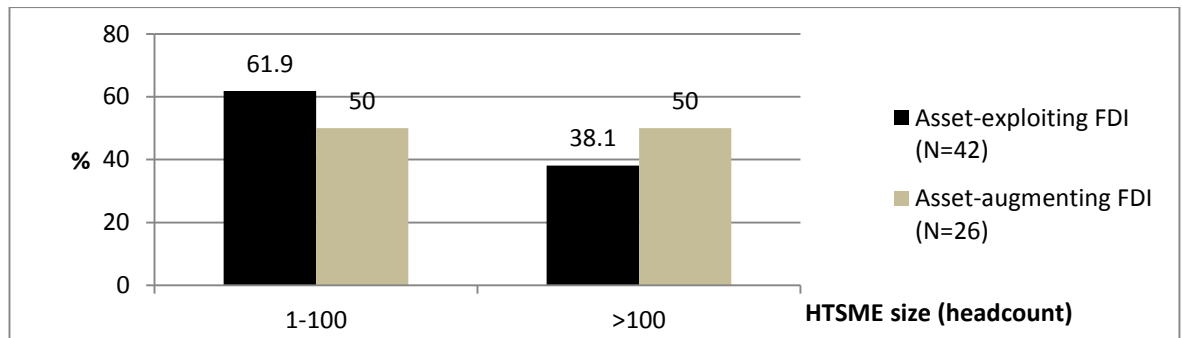


Chi-Square: $\chi^2 (1, N = 68) = .036, p = .849, \phi = .023$.

Firm size (headcount of employees): In terms of the firm size, a Chi-Square Test revealed no significant association between HTSME size and type of FDI. As Figure 6.7 summarises, the percentage of asset-augmenting firms is equal for both groups. For the asset-exploiting

HTSMEs, there is a tendency towards smaller firm size. However, this tendency is not significant.

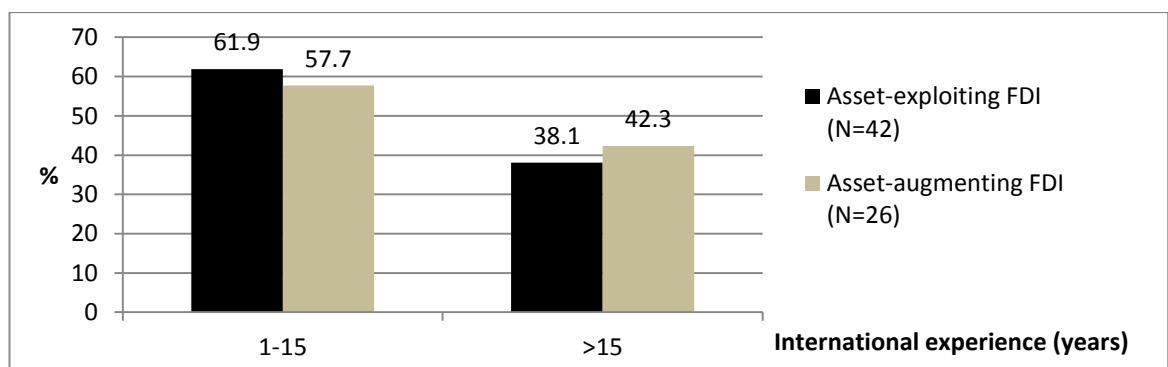
Figure 6.7 Type of FDI in relation to HTSME size



Chi-Square: $\chi^2 (1, N = 68) = .507, p = .476, \phi = .117$.

International experience (years operating abroad): For the international experience of the HTSMEs, a Chi-Square Test showed no significant association between international experience and type of FDI. Figure 6.8 outlines that HTSMEs engaging in either type of FDI are similarly distributed among the two different groups.

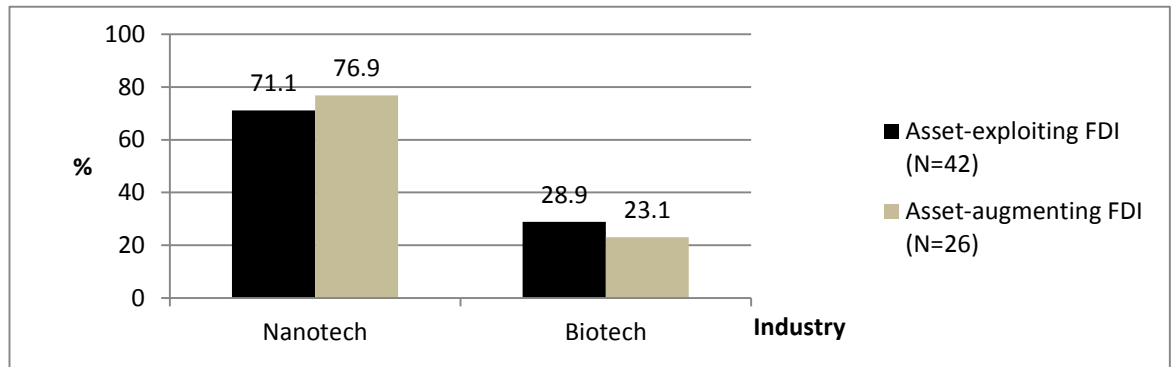
Figure 6.8 Type of FDI in relation to the HTSME's international experience



Chi-Square: $\chi^2 (1, N = 68) = .043, p = .835, \phi = .056$

Industry: A Chi-Square Test indicated no significant association between industry and type of FDI. Figure 6.9 outlines that the allocation of the firms among the two industries is very similar for asset-exploiting and asset-augmenting HTSMEs.

Figure 6.9 Type of FDI in relation to the industry

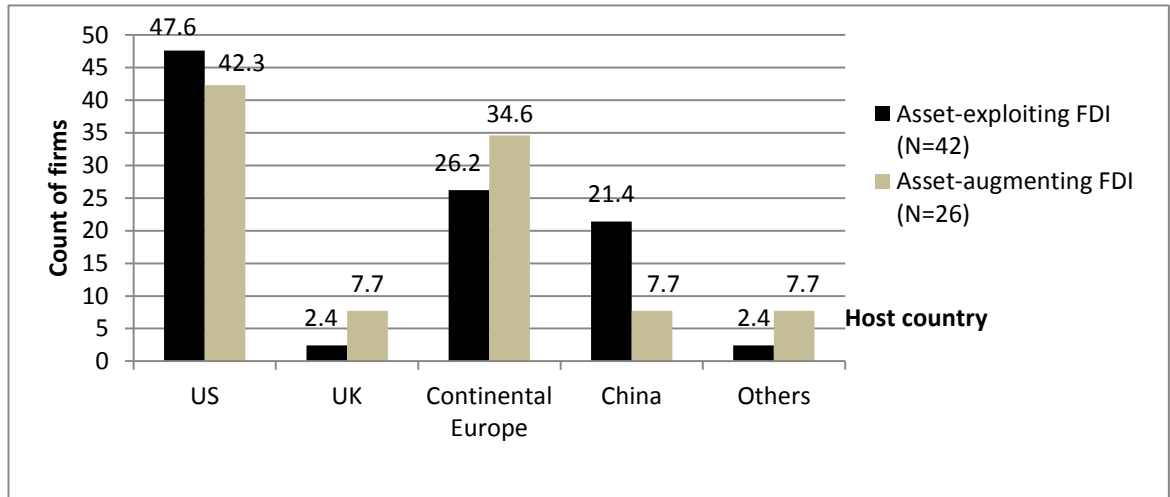


Chi-Square: $\chi^2 (1, N = 68) = .047, p = .829, \phi = .061$

In which countries/regions do HTSMEs with asset-exploiting FDI and asset-augmenting FDI invest?

A Chi-Square Test was applied to investigate if there is an association between HTSMEs with asset-augmenting FDI and liberal market economies. The US and UK were defined as liberal market economies while the remaining host countries were defined as non-liberal market economies (following the varieties of capitalism framework by Hall and Soskice, 2001). The Chi-Square Test showed no significant association between innovation system and type of FDI. In fact, the frequencies showed that exactly 50% of the asset-augmenting HTSMEs as well as of the asset-exploiting HTSMEs undertook FDI in a liberal market economy (US and UK). Figure 6.10 visualises the frequencies of asset-exploiting and asset-augmenting FDI into the different countries/regions.

Figure 6.10 Type of FDI in relation to the host country



Chi-Square: $\chi^2 (1, N = 68) = .000$, $p = 1.000$, $\phi = .000$.

Summary of the findings related to the similarities and differences in firm characteristics between HTSMEs with asset-exploiting FDI and HTSMEs with asset-augmenting FDI:

- HTSMEs with asset-exploiting and asset-augmenting FDI are very similar in terms of firm age.
- HTSMEs with asset-augmenting FDI are not significantly larger than HTSMEs with asset-exploiting FDI.
- HTSMEs with asset-exploiting and asset-augmenting FDI are very similar in terms of international experience.
- The industry affiliation of HTSMEs with asset-augmenting FDI does not differ to HTSMEs with asset-exploiting FDI.
- HTSMEs with asset-augmenting FDI do not invest significantly more in host countries that are characterised as liberal market economies than HTSMEs with asset-exploiting FDI.

6.4 Regression models and results

6.4.1 Introduction

The following section provides the results of the logistic regression analysis. It starts with the control model in which only the control variables were regressed on the dependent variable, i.e. *Type of FDI*. Subsequently, the four main models (Table 6.1) representing the research hypotheses developed in Chapter 4 were regressed on the dependent variable. This procedure and the subsequent presentation of the results are in line with common practice in the field (Lewin et al, 2009; Pinho, 2007). A summary of the regression results is presented at the end of this chapter in Table 6.2.

6.4.2 Control variables in the regression analysis

Due to the relatively small sample size in this study and the consequential constraints faced by the limited amount of degrees of freedom in the regression analysis, this study excluded insignificant control variables from the main regression analysis (Hair et al, 2006). This procedure is in line with related studies in the field. The diagnostics of the model containing all control variables showed that the control model is insignificant with low R^2 type measures such as Nagelke R^2 (0.035). None of the control variables showed a positive or negative significant relationship with the dependent variable. In other words, the control variables did not show a significant difference between the HTSMEs that undertake asset-exploiting FDI and HTSMEs that undertake asset-augmenting FDI. In a subsequent step, simple individual regressions with each control variable confirmed the results of the control model showing no significant relationship for any variable. This insignificance remained when the control variables *Age*, *Size* and *International Experience* were put in categories and the regressions were rerun. Therefore, as the control model and the individual regressions of the control variables were not significant, no control variables were included in the main regression models containing the O and L-advantages.

6.4.3 Logistic regression results

This section provides the results of the logistic regression analyses answering the research questions 3 and 4:

Which O-advantages are relevant to the asset-exploiting and asset-augmenting FDI of HTSMEs?

Which L-advantages are important for the asset-exploiting and asset-augmenting FDI of HTSMEs?

6.4.3.1 Model diagnostics

The diagnostics show that three out of four models (the O-exploiting, O-augmenting and L-augmenting models) perform well (see Table 6.1). The model chi-square of the two augmenting models is highly significant at the 1% level and significant at the 5% level for the O-exploiting model. This demonstrates the meaningfulness of these models. The explained variance of the three models expressed by R^2 type measures such as Nagelke R^2 ranges between 0.264 – 0.787. These values are in line with or above related cross sectional studies that applied logistic regression analysis (such as Lewin et al, 2009; Majeed et al, 2011; Pinho, 2007; Sawers et al, 2008; Schmiele, 2012). However, the model diagnostics also outline that the L-exploiting model is insignificant and has a low Nagelke R^2 (0.040). An explanation for this unexpected result will be discussed in section 6.4.3.4. The following sections outline the results for the research hypotheses.

6.4.3.2 O-exploiting advantages and FDI activities

This section presents the results of the O-exploiting model and hypotheses H1a-H1e. These hypotheses predicted positive relationships between the O-exploiting advantages and the HTSME's engagement in asset-exploiting FDI. In other words, the hypotheses expected a negative significant relationship between O-exploiting advantages and the HTSME's engagement in asset-augmenting FDI. As summarised in Table 6.1, the negative coefficients

of all five variables in the model support the hypothesised direction of the relationships. In particular, hypothesis H1d suggests a relationship between the HTSME's ability to provide an internal support structure and asset-exploiting FDI was supported ($p < 0.05$). Furthermore, the ability of taking advantage of scale economies represented in hypothesis H1e found support in the model ($p < 0.05$). The hypothesis H1a was not supported indicating that the HTSME's ability to develop differentiated products is not more important for asset-exploiting FDI than for asset-augmenting FDI. Similarly, the hypothesis H1b predicts a relationship between the HTSME's higher ability to adapt firm-specific technology to foreign markets and its engagement in asset-exploiting FDI was not statistically significant and therefore not supported. The same pattern emerged for hypothesis H1c predicting a significant positive relationship between the HTSME's ability to develop patents and its engagement in asset-exploiting FDI. The hypothesis was not supported, which suggests that the ability to develop patents does not differ significantly between HTSMEs that engage in asset-exploiting and asset-augmenting FDI.

6.4.3.3 O-augmenting advantages and FDI activities

This section presents the results of the O-augmenting model embracing the research hypotheses H2a-H2e. These hypotheses formulated the expected significant positive relationships between the HTSME's O-augmenting advantages and its engagement in asset-augmenting FDI. The particular results of the O-augmenting model show full support ($p < 0.01$) for hypothesis H2c, which indicates that HTSMEs with higher absorptive capability are more likely to undertake asset-augmenting FDI. Furthermore, hypothesis H2d found full support in the model at the 1% level. It suggested that a stronger internal knowledge network of the HTSME raises the likelihood of its engagement in asset-augmenting FDI. With respect to hypothesis H2a, implicating a relationship between the HTSME's innovative capability and asset-augmenting FDI, no support was found. In terms of the size of the R&D network formulated in hypothesis H2b, the results show no significant

differences between asset-augmenting HTSMEs and asset-exploiting HTSMEs. Finally, the results reveal that HTSMEs engaging in asset-augmenting FDI do not have a higher ability to implement the knowledge accessed abroad as hypothesised in hypothesis H2E. Therefore, the hypothesis is not supported.

6.4.3.4 L-exploiting advantages and FDI activities

This section presents the results of the L-exploiting model. It contains the hypotheses H3a-H3b, which proposed a positive relationship between the host country's L-exploiting advantages and HTSMEs' engagement in asset-exploiting FDI in these locations. However, none of the variables in the model reached statistical significance due to a lack of response variation as managers of asset-exploiting and asset-augmenting HTSMEs rated the variables equally high. As the descriptive statistics outline, market factors¹⁰ are very important for both asset-exploiting HTSMEs (mean 6.55, SD 0.916) and asset-augmenting HTSMEs (mean 6.19, SD 1.096). This indicates that market factors are always very important regardless of which type of FDI the HTSME engages in. Thus, it would be misleading to neglect market factors as an explanation for the FDI of HTSMEs due to the insignificance of the L-exploiting model. With respect to cost factors, the descriptive statistics show exactly the same mean value for asset-exploiting HTSMEs (mean 3.38, SD 2.060) and asset-augmenting HTSMEs (mean 3.38, SD 2.210). This shows that cost factors are not more or less important for either type of HTSME.

6.4.3.5 L-augmenting advantages and FDI activities

This section presents the results of the L-augmenting model and relationships between the L-augmenting advantages and the HTSME's engagement in asset-augmenting FDI. These relationships were formulated in research hypotheses H4a-H4f. The results of the model

¹⁰ The variable was measured on a 7-point Likert-scale.

show full support for hypothesis H4b at the 1% level. This hypothesis suggests that the abundance of highly skilled human capital in the host country is more important for HTSMEs that engage in asset-augmenting FDI. Similarly, the proximity to scientific institutions and innovative firms in the host country hypothesised in H4c was supported and reached significance at the 5% level. Moreover, the proximity to industrial concentrations in the host country was found to be more important for asset-augmenting HTSMEs than for asset-exploiting HTSMEs ($p < 0.05$). This leads to the support of hypothesis H4e. Furthermore, the results show that there is no support for hypothesis H4a indicating that an institutional environment conducive to innovation activities in the host country is more important for asset-augmenting HTSMEs than for asset-exploiting HTSMEs. In terms of the home country disadvantage reflected in hypothesis H4f, the results show no significant differences between HTSMEs that undertake asset-exploiting FDI and HTSMEs that engage in asset-augmenting FDI. Therefore, hypothesis H4f was not supported. Finally, in contrast to hypothesis H4d, the results show weak support ($p < 0.1$) for the importance of innovative suppliers for asset-exploiting HTSMEs. This led to the rejection of hypothesis H4d.

Table 6.1 Regression results

Variables	Control model	O-exploiting model	O-augmenting model
Control variables			
Age	0.835 (1.479)		
Size	-0.116 (0.677)		
International Experience	-0.120 (0.296)		
Industry	-0.506 (0.637)		
Independent variables			
Product Differentiation		- 0.141 (0.256)	
Technology Adaptation		- 0.173 (0.190)	
Patent Development		- 0.417 (0.962)	
Internal Support Structure		- 0.664 (0.306)**	
Scale Economies		- 1.369 (0.663)**	
Innovative Capability			1.771 (1.663)
R&D Network			0.315 (0.408)
Absorptive Capacity			2.551 (0.884)***
Internal Knowledge Network			2.023 (0.763)***
Foreign Knowledge Implementation			- 0.545 (0.334)
Constant	-1.306 (1.248)	7.661 (2.631)	-25.900 (8.306)***
Model Chi Square	0.950	14.689**	57.606***
Log likelihood	87.570	75.778	30.915
Nagelke R ²	0.019	0.264	0.787
Percent correctly classified	62.7	77.9	88.1
N (cases)	67	68	67

(i) Standard errors in brackets

(ii) Significant levels: ***<1%, **<5%, *<10% (2-tailed)

(iii) A negative coefficient denotes that the advantage is more likely related to asset-exploiting FDI, and a positive coefficient that it is more likely related to asset-augmenting FDI.

Table 6.1 continued: Regression results

Variables	L-exploiting model	L-augmenting model
Independent variables		
Cost Factors	-0.010 (0.812)	
Market Factors	-0.357 (0.257)	
Institutional Environment		-0.614 (0.409)
Abundance Highly Skilled Human Capital		12.266 (3.960)***
Prox. Scientific Institutions/Innovative Firms		1.091 (0.484)**
Prox. Innovative Suppliers		-5.036 (2.593)*
Prox. Industrial Concentrations		0.640 (0.301)**
Home Country Disadvantage		-0.752 (0.480)
Constant		-7.675 (3.016)**
Model Chi Square	2.029 ¹¹	56.018***
Log likelihood	88.439	32.503
Nagelke R ²	0.040	0.773
Percent correctly classified	66.2	85.1
N (cases)	68	67

(i) Standard errors in brackets

(ii) Significant levels: ***<1%, **<5%, *<10% (2-tailed)

(iii) A negative coefficient denotes that the advantage is more likely related to asset-exploiting FDI, and a positive coefficient that it is more likely related to asset-augmenting FDI.

¹¹ Due to a lack of variation in the responses the model remains insignificant. However, market factors were ranked as very important by both asset-exploiting and asset-augmenting HTSMEs (see section 6.4.3.4).

Table 6.2 Summary of the empirical findings

Model	Hypothesis	Independent variable	Result
O-exploiting	H1a	Product Differentiation	Not supported
	H1b	Technology Adaptation	Not supported
	H1c	Patent Development	Not supported
	H1d	Internal Support Structure	Supported at 5%
	H1e	Scale Economies	Supported at 5%
O-augmenting	H2a	Innovative Capability	Not supported
	H2b	R&D Network	Not supported
	H2c	Absorptive Capacity	Supported at 1%
	H2d	Internal Knowledge Network	Supported at 1%
	H2e	Foreign Knowledge Implement.	Not supported
L-exploiting	H3a	Cost Factors	Not supported
	H3b	Market Factors	Not supported
L-augmenting	H4a	Institutional Environment	Not supported
	H4b	Abundance Skilled Human Cap.	Supported at 1%
	H4c	Prox. Scien. Institu & Innov. Firms	Supported at 5%
	H4d	Prox. Innovative Suppliers	Rejected at 10%
	H4e	Prox. Industrial Concentrations	Supported at 5%
	H4f	Home Country Disadvantage	Not supported

6.5 Summary of the chapter

The underlying chapter commenced with an introduction, the discussion of missing values and several pre-tests and post estimation procedures in order to meet the required assumptions for further regression analysis. Furthermore, several tests were conducted to ensure that this study reduced the likelihood of common method bias. Then, a randomly split sample test indicated that the regression models are robust and hold. These sections were followed by the presentation of the descriptive statistics and univariate analysis answering research questions 1 and 2. Subsequently, the results of the regression models were presented in order to answer research questions 3 and 4. The predictions of the conceptual framework were partially supported as three out of four models were significant. The insignificance of the L-exploiting model indicates that the L-exploiting advantages accumulated in the model are not more significant for asset-exploiting HTSMEs than for asset-augmenting HTSMEs.

The following chapter will discuss this result in detail within an extensive discussion of all regression results.

7 Discussion

7.1 Introduction

This study explains if the envelope paradigm can serve as an analytical framework for understanding the FDI of HTSMEs. This chapter discusses the main findings of the empirical investigation presented in chapter 6. It commences with a discussion of the tests of association related to the first research question, which concerns the extent of HTSMEs' FDI and non-equity entry to foreign markets. It was further interested in the differences between HTSMEs with FDI and HTSMEs with non-equity entry in terms of basic firm characteristics. The chapter proceeds with a discussion of the second research question, which concerned the extent of the asset-exploiting and asset-augmenting FDI of HTSMEs and the firm characteristics of the HTSMEs engaging in either type of FDI. Then the chapter discusses the findings related to the third research question, concerning the relationships between the HTSME specific O-advantages and the type of FDI, and the fourth research question, concerning the relationship between the location specific L-advantages and type of FDI. Finally, the chapter concludes with a discussion of the fifth research question, which has been directly derived from the overall research aim of this study. It discusses if the envelope paradigm can serve as an analytical framework for understanding the FDI activities of HTSMEs. Thus, this study advances existing knowledge by providing new empirical results to evaluate if the adopted envelope paradigm framework holds and is able to explain the asset-exploiting and asset-augmenting FDI of HTSMEs. The discussion can be seen as a response to the repeated request in HTSME internationalisation literature for researchers to test if an integrated framework of relevant theories can overcome the conceptual limitations of commonly adopted IB theories and frameworks (Coviello and McAuley, 1999; Dana et al, 1999; Kuivalainen et al, 2012; McAuley, 2010; Ruzzier et al, 2006).

7.2 Equity and non-equity entry of HTSMEs in light of firm-specific characteristics

7.2.1 The foreign entry modes of HTSMEs

This section discusses the results of the descriptive analyses and the univariate tests for differences in order to answer the first research question.

- 1) *To what extent do HTSMEs undertake FDI and non-equity entry modes?*
 - a) *How do firm characteristics differ between HTSMEs that undertake FDI and HTSMEs that engage in non-equity entry modes?*
 - b) *In which countries/regions do HTSMEs undertake FDI?*

The results presented in Chapter 6 showed that over one-third of the internationalised HTSMEs in the sample engage in FDI. Comparability of this result with other studies is limited due to a lack of previous empirical research in the field of HTSMEs and FDI. However, the equity entry of one-third of the firms is higher than the results of related studies of non-high-tech SMEs and FDI. Pinho (2007) found that one-fifth of the SMEs in his sample engage in FDI. Therefore, the findings of this study support the assumptions of previous research that HTSMEs engage more frequently in resource intensive modes of entry than non-high-tech SMEs (Crick, 2009; Li et al, 2011; Maine et al, 2010). An explanation might be that the establishment of a foreign subsidiary in a location where desired technological advantages are bundled, is a major possibility for HTSMEs to facilitate the development of new value-creating assets and capabilities. This explanation is in line with Li et al (2011) who provide support for the relationship between country specific advantages available to the HTSME's foreign subsidiary and HTSME performance. Another explanation could related to the specific context of high-tech. As Phene et al (2006) suggest, firms within high-tech industries are particularly required to access and integrate competitive advantages that are embedded in different international locations.

A further explanation for the higher share of equity entry of HTSMEs relates to the HTSME's risk of losing proprietary tacit knowledge and informal routines that provide a

competitive advantage to alliance partners. This explanation is in line with Schwens et al (2011:344) who suggest that “firms internalize transactions when they perceive high risk of opportunistic behaviour by foreign market players from different cultural backgrounds. SMEs have to safeguard their knowledge to prevent the loss of competitive advantages through the opportunistic behaviour of other foreign market players.” Furthermore, the finding is in line with Li et al’s (2011) findings that the establishment of a foreign subsidiary provides a valuable alternative, especially for early internationalising HTSMEs due to their inability to develop mutual trust with foreign partners. Hence, equity entry mitigates the difficulties of processing information and knowledge in international partnerships due to the inaccuracy of contractual determinations of the obligations and responsibilities of international partners.

In terms of the firm-specific characteristics of HTSMEs that engage in FDI, the findings revealed that older, larger and international experienced HTSMEs are more likely to undertake FDI. This provides complementary implications for the HTSME entry mode literature. As the extensive literature review of this study showed, current HTSME entry mode studies have claimed that the implications of traditional stage approaches (see section 3.4.3.2) are less valid for the internationalisation process of HTSMEs (see summary of the literature review in section 3.4.4). However, these studies have mainly focused on export and non-equity modes of entry. The findings of this study contribute a wider understanding of the HTSME internationalisation process including both equity and non-equity entry modes. They show that the engagement in FDI is related to the HTSME’s international experience, size and age. This finding is in line with the result of Schwens et al (2011) who showed that international experienced SMEs are more likely to choose equity based entry modes. Furthermore, the finding that HTSMEs mainly undertake FDI in the US and Western Europe is in line with previous expectations developed in this study that German HTSMEs seek to invest in countries with a similar cultural background and a stable institutional

environment (Ambos, 2005; Rammer and Schmiele, 2008). This result supports previous findings suggesting that German MNEs prefer investments in developed economies with large markets that additionally exhibit advanced knowledge levels such as the US (Ambos, 2005; Federal Ministry for Education and Research, 2010).

7.2.2 The extent of asset-exploiting and asset-augmenting FDI of HTSMEs

This section discusses the results of the descriptive analyses and the univariate tests for differences in order to answer the second research question.

2) What is the extent of asset-exploiting and asset-augmenting FDI of HTSMEs?

- a) How do firm characteristics differ between HTSMEs that undertake asset-exploiting FDI and HTSMEs that engage in asset-augmenting FDI?*
- b) In which countries/regions do HTSMEs with asset-augmenting FDI and HTSMEs with asset-exploiting FDI invest?*

Of the HTSMEs in the sample that have undertaken FDI, nearly two-fifth engage in asset-augmenting activities. This indicates that a considerable amount of HTSMEs engages in knowledge seeking FDI activities. It confirms the implications of the KBV in HTSME internationalisation research (section 3.4.3.5) highlighting the importance for HTSMEs to focus on the specialised knowledge related resources gained from international sources. Furthermore, the tendency of HTSMEs to engage in knowledge seeking FDI activities is in line with the wider IB literature on larger MNEs, showing that firms increasingly undertake FDI to augment their knowledge base (Frost, 2001; Kuemmerle, 1999a; Phene and Almeida, 2008). This study is one of the first to provide empirical implication that asset-augmenting FDI is a common entry mode of HTSMEs. Older research showed that knowledge-intensive SMEs usually keep their knowledge related activities in the home country (Almor and

Hashai, 2002). However, more recently, Abidi et al (2011) suggest that HTSMEs increasingly orient themselves towards foreign asset-augmentation via the mode of FDI. This claim is confirmed by the findings of this study. Furthermore, the findings are in line with the results of Li et al (2013) who show that innovative HTSMEs do internalise foreign operations in order to enhance their strategic assets abroad.

Regarding the differences in firm-specific characteristics between HTSMEs that engage in asset-exploiting and asset-augmenting FDI, the study did not find significant differences in terms of HTSME age, size, international experience and industry. This is an interesting finding as the general subsidiary literature in IB suggests that subsidiary development is often an evolutionary process related to firm size and international experience commencing with exploiting activities and continuously including further knowledge augmenting activities (Blomkvist et al, 2010). An explanation might be derived from the HTSME specific context, as these firms do not view potential limitations based on a lack of size or international experience as drawbacks for achieving specific FDI objectives such as foreign knowledge augmentation. This proactive and risk seeking behaviour of the HTSME in its internationalisation has been extensively described in the international entrepreneurship literature (section 3.3). Nevertheless, since basic firm characteristics seem to be less informative regarding the HTSME's engagement in different types of FDI, the discussion of the regression results of this study in Chapter 7 will be able to provide deeper insights regarding the factors influencing the HTSME's engagement in different types of FDI.

Concerning the host location of the FDI of HTSMEs with asset-exploiting and augmenting activities, the results did not show the expected relation between asset-augmenting FDI and liberal market economies (US and UK) as derived from the national systems of innovation literature (Hall and Soskice, 2001). Therefore, the finding indicates that the German innovation system might not be less conducive to radical innovation. This implication will

be further discussed in detail in section 7.3.4. In general, the results reveal that liberal market economies are equally targeted by HTSMEs with asset-augmenting FDI and HTSMEs with asset-exploiting FDI. Half of all FDI streams from German HTSMEs go to these two countries with the vast majority to the US. This shows that the US is the key target country for both FDI types. A possible explanation might be the twofold nature of the US in terms of high-tech industries and high-tech products as described by Sachwald (2008). On the one hand, its radical and permeable innovation system provides extensive sources for high-tech innovation, as it is a key location to promote organisational learning with its exceptional infrastructure, highly skilled workforce and advanced science base (Colakoglu et al, 2014). Thus, it attracts the asset-augmenting FDI of HTSMEs. On the other hand, the US is the largest market for high-tech products where international high-tech firms generate major shares of their revenue (Fifarek and Veloso, 2010; Li et al, 2011). Accordingly, HTSMEs have a high interest in conducting sales and distribution activities in the US in order to serve the large US customer base. The descriptive statistics of the market factor variable supported this claim showing very high importance of market factors for both asset-augmenting and asset-exploiting HTSMEs (see Appendix B2). Therefore, it appears that the US is equally highly important for asset-augmenting and asset-exploiting activities of HTSMEs.

In general, the results regarding the foreign location of asset-augmenting FDI are in line with Kuemmerle's (1999a) seminal findings on the location of the asset-augmenting FDI of MNEs. Both studies found that the key locations for asset-augmenting FDI are the US, Western Europe and Japan while other locations represent exceptions. However, this finding does not concur with the results of Schmiele (2012) who found that German MNEs seem to locate innovation activities in medium developed countries (such as Eastern Europe) rather than in advanced countries (such as US). From a mainstream IB perspective, this might be attributed to the fact that larger MNEs might seek to take advantage of location factors that support the reduction of innovation costs. This reasoning might not be as important for

smaller SMEs in the high-tech context. These firms compete on a technological level rather than on a cost level (as outlined in section 2.3). The descriptive statistics of this study provide further support for this claim showing that cost factors were not seen as important location factors of neither asset-exploiting nor asset-augmenting HTSMEs. Therefore, it seems that HTSMEs that engage in asset-exploiting FDI are less interested in the establishment of a subsidiary in locations, which specifically provide cost advantages. A possible explanation could be that the focus of HTSMEs' asset-exploiting activities is on sales activities rather than on production activities. A frequency analysis of the foreign activities of the HTSMEs supported this claim. Hence, this could explain the HTSMEs' preference of locations with a large market for high-tech products rather than a location that provides cost advantages.

7.3 The FDI of HTSMEs in light of O and L-advantages

This section discusses the results of the regression analyses in order to answer the research questions 3 and 4.

- 3) *Which O-advantages are relevant to the asset-exploiting and asset-augmenting FDI of HTSMEs?*
- 4) *Which L-advantages are important for the asset-exploiting and asset-augmenting FDI of HTSMEs?*

This study is one of the very first to particularly investigate asset-exploiting and asset-augmenting FDI from the perspective of the HTSME. Therefore, the findings will be discussed within the HTSME context as well as the MNE context in order to provide a comprehensive discussion of this comparatively new research area. This will further contribute to the subsequent discussion of the overall research objective, to test if the adopted envelope paradigm framework in this study holds in the new context of the FDI of HTSMEs.

7.3.1 O-exploiting advantages and the FDI of HTSMEs

Based on an assessment of the existing theoretical and empirical literature on asset-exploiting FDI (section 3.4.5.3), the O-exploiting model was developed to test the ownership factors, which are supposed to be particularly relevant to HTSMEs engaging in asset-exploiting FDI. Overall, the results show partial support for the hypothesised relationships between O-exploiting advantages and the asset-exploiting FDI of HTSMEs. Out of the five variables in the model, the two variables *Internal Support Structure* and *Scale Economies* showed an individual association with asset-exploiting FDI. These relationships were hypothesised based on the internalisation theory (section 3.4.3.1) and the efficiency seeking FDI perspective (section 3.4.5.3). This finding shows that the ability to support foreign production and sales, and the ability to reduce unit costs through larger production volumes seem to be relevant factors for HTSMEs to undertake asset-exploiting FDI (as hypothesised in H1d and H1e). However, this finding cannot be compared to other HTSME and FDI studies due to a lack of empirical research in this new field of HTSMEs and FDI.

Nevertheless, this finding is concordant with the related MNE subsidiary literature emphasising the importance of the headquarters' support in terms of the provision of resources and knowledge outside the subsidiary's daily routine such as manufacturing capabilities, organisation practices, marketing skills and after sales service (Ambos and Mahnke, 2010; Ciabuschi et al, 2012). Moreover, the finding is consistent with the literature suggesting that a sufficient internal support structure and the related increases in efficiency have a leveraging effect on the firm's scale economies (Makides, 2002). It confirms that being active in foreign markets allows the firm to achieve economies of scale and to increase foreign market presence (Schmiele, 2012). In the particular HTSME context, the finding contributes to Li et al's (2013) conclusion that HTSMEs require foreign market expansion to achieve larger volumes and scale economies. It further supports Fan and Phan (2007) who claimed that HTSMEs tend to internationalise quickly to overcome the drawbacks related to

a reduced output mass. Accordingly, the enhancement of the output mass is supposed to result in decreased costs per unit.

The remaining three variables in the O-exploiting model, *Product Differentiation*, *Technology Adaptation* and *Patent Development*, do not support the theoretical implications pointing to differences between their relevance for asset-exploiting and asset-augmenting HTSMEs. Therefore, this finding suggests that higher abilities in these ownership factors are not more relevant to asset-exploiting HTSMEs. Regarding *Product Differentiation*, the result was unexpected as in accordance with the contribution of Caves (1971) and the RBV (Wernefelt, 1984), this study hypothesised that higher product differentiation abilities are required to exploit proprietary firm technology abroad (H1a). An explanation might be that due to the lack of specific HTSME FDI studies, the conceptual reasoning leading to the development of the product differentiation hypothesis was based on previous studies that had a slightly different focus (Brouthers et al, 1996; Majeed et al, 2011; Pinho, 2007). While these studies investigate and demonstrate differences in product differentiation abilities between SMEs with equity and non-equity entry, this study was the first to investigate particularly the differences between HTSMEs that engage in different types of FDI. Therefore, the findings of this study extend existing knowledge in SME entry mode research. While previous research show differences in the product differentiation abilities between SMEs with non-equity entry and FDI (Pinho, 2007), this study shows that product differentiation abilities do not differ between firms with asset-exploiting and asset-augmenting FDI.

Another explanation for the insignificance of the variable might be that following the notion of the KBV in specific context of high-tech (section 3.4.3.5), the ability to develop differentiated products could be seen as a basic requirement for the firm to develop and maintain a competitive advantage in a highly internationalised high-tech market (see section

2.2). Thus, the underlying finding would imply that in the specific context of HTSMEs, the product differentiation advantage denotes a prerequisite for the existence of the HTSME, rather than a specific advantage that should be attributed to HTSMEs engaging in asset-exploiting FDI. This reasoning might apply as well as an explanation for the unexpected insignificance of the hypothesised relationship between *Technology Adaptation* and asset-exploiting FDI (H1b). Both *Product Differentiation* and *Technology Adaptation* could be similarly relevant for exploiting and augmenting HTSMEs as products and activities might be contextual in the high-tech context. This reasoning is in line with the OECD (1996) delineating that technology adaption is a standard requirement in knowledge-based economies. The mean analysis of this study provide support for this explanation showing that the mean scores for the abilities in *Technology Adaptation* are similarly high for both asset-exploiting and asset-augmenting HTSMEs (see Appendix B2).

In terms of the insignificant *Patent Development* variable, the finding does not fit the hypothesised relationship between the HTSME's ability to develop patents and its engagement in asset-exploiting FDI (H1c). Hence, it is not in line with the underlying theoretical proposition that the ability to develop patents is a condition that enables the firm to exploit its specific advantages abroad (Dunning, 1993; Hymer, 1960). In fact, the mean analysis in this study showed that the ability to develop patents received average scores for both asset-exploiting and asset augmenting-HTSMEs (see Appendix B2). An explanation for the medium importance and lack of variation between the HTSMEs engaging in different types of FDI might stem from the fact that the protection against counterfeiting and illegal adoption of firm-specific technology via patenting includes high financial efforts. However, due to size constraints, HTSMEs face limitations in terms of financial, managerial and legal assets to cope with these financial efforts (see section 2.3). Therefore, it could be that HTSMEs in general, regardless of their engagement in either exploiting or augmenting FDI, do not possess sufficient resources to organise patent registrations and legal enforcement in

the global market place efficiently. This explanation receives empirical support from Li et al (2013) who claim that due to the lack of essential resources, HTSMEs are forced to accept the increased risk of asset expropriation. An additional factor explaining why patenting is not related to the asset-exploiting HTSMEs might relate to the high speed of product obsolescence in high-tech industries (see section 2.2). This high pace of new technological knowledge creation and the very short product lifecycles might function as a natural mitigation against the risk of losing proprietary knowledge. Therefore, HTSMEs might rather invest their limited resources in the development of new technologies instead of the protection of existing technologies.

7.3.2 O-augmenting advantages and the FDI of HTSMEs

Drawing on the theoretical implications of the asset-augmenting FDI perspective (section 3.4.5.4) and the KBV in HTSME internationalisation (section 3.4.3.5), the proposed O-augmenting model was developed to test the ownership factors that are supposed to be relevant to asset-augmenting HTSMEs (Dunning, 2000; Kuemmerle, 1999a). Overall, two out of five variables in the model show a positive significant relationship with asset-augmenting FDI while three variables found no support. In particular, the *Absorptive Capacity* and *Internal Knowledge Network* variables were highly significant in the context of the asset-augmenting FDI of HTSMEs.

In terms of *Absorptive Capacity*, the finding is consistent with the dynamic capabilities perspective in HTSME internationalisation (section 3.4.3.6). It shows that the hypothesised ability to understand, acquire and integrate new knowledge (Cohen and Levintal, 1990) is highly relevant for asset-augmenting HTSMEs (H3c). Thus, the finding confirms that greater abilities in understanding and acquiring new knowledge abroad can be associated with an increase in the probability of the HTSME undertaking asset-augmenting FDI. This is in line with the notion of the KBV (section 3.4.3.5) showing that the absorption and integration of

superior foreign knowledge and technological skills leverages asset-augmenting FDI, and increases the innovative capability of the HTSME. This result corresponds with empirical implications of the MNE and FDI literature suggesting that firms with higher absorptive capacity are more likely to undertake FDI for R&D and knowledge sourcing purposes (Ambos et al, 2006; Mahnke et al, 2005; Schmiele (2012). Moreover, the finding extends previous HTSME research showing a relationship between absorptive capacity and HTSME non-equity entry for knowledge sourcing purposes (Carayannis et al, 2006; De Jong and Freel, 2010). It adds empirical evidence that the theoretical implications of the absorptive capacity concept in HTSME internationalisation research does not only apply for non-equity entry but also for the HTSME's foreign knowledge sourcing via asset-augmenting FDI.

Similarly, the *Internal Knowledge Network* variable showed a strong relationship to asset-augmenting FDI. This finding supports the proposed arguments based on the KBV (section 3.4.3.5) and the network perspective of organisational learning (Tsai, 2001), that the HTSME's foreign asset-augmenting activities are very dependent on its ability to organise the reciprocal knowledge flows between headquarters and subsidiary (H3d). In other words, HTSMEs, which are able to create an internal exchange network for specific knowledge, capabilities and technical and administrative functions are more likely to undertake asset-augmenting FDI. The finding provides empirical support for previous claims that the firm's internal exchange network should be an arrangement that can enhance its flexibility for undertaking international knowledge sourcing activities and facilitate its efficient use of knowledge resources between sub-units (Arvanitis and Hollenstein, 2011; Cegarra-Navarro and Sánchez-Polo, 2011; Meyer et al, 2011). This problem of internal knowledge exchange has been previously outlined as a key challenge for international knowledge sourcing firms (Asakawa and Lehrer, 2003; Song et al, 2011). Hence, the underlying finding confirms that a functional internal knowledge network helps to overcome the problems related to the availability and accessibility of knowledge within the firm (Narula and Santangelo, 2012),

and the problems related to sticky knowledge (Von Hippel, 1994). Therefore, it facilitates the HTSME's asset-augmenting activities.

No significant relationship was found between asset-augmenting FDI and the HTSME'S *Innovative Capability*, *R&D Network* and *Foreign Knowledge Implementation* as hypothesised in H2a, H2b and H2e. In terms of the *Innovative Capability*, this result is not in line with the notion of the KBV (section 3.4.3.5) that superior knowledge and technological skills increase the innovative capabilities of the HTSME, which is related to its engagement in asset-augmenting activities. Again, as there is little empirical evidence in the specific HTSME and FDI context, this finding has be further discussed in the context of studies that looked at the same aspect in the broader MNE field. In this broader context, the underlying finding is not in line with the proposition of FDI studies suggesting that the innovative capability of the firm is associated with the asset-augmenting FDI of the firm (Kumar, 2007; Lee and Rugman, 2011; Liu and Buck, 2007). However, Ito and Wakasugi (2007) for example show in their study only a marginal effect for a positive relationship between the parent firm's innovative capability and the engagement in foreign R&D. The descriptive statistics of this study also reveal a marginal higher mean score of *Innovative Capability* for asset-augmenting HTSMEs (see Appendix B2). Nevertheless, the difference to asset-exploiting HTSMEs is not significant. Pinho (2007) might provide an explanation as he shows in the specific SME context that *Innovative Capability* is a significant predictor for the FDI of SMEs in general. This implies that it is important for both foreign asset-exploitation and asset-augmentation. The context of HTSMEs in high-tech industries lends support to this explanation. As high-tech industries are reliant on technological innovativeness and intellectual capital (see section 2.2), it might be that a high *Innovative Capability* is a basic condition for the HTSME to exist. Thus, it could be that it is not significantly more relevant to asset-augmenting HTSMEs than to asset-exploiting HTSMEs. As Makino et al (2002) outlined, foreign asset-exploitation requires that the firm possesses

certain forms of rent-yielding resources. In the context of HTSMEs, it is likely that this resource is the innovative capability, which provides the firm with a competitive advantage over host country competitors (Alegre et al, 2011; Haeusler et al, 2012).

Regarding the insignificance of the *R&D Network* of the HTSME, the finding is not in line with the theoretical proposition based on network theory (3.4.3.3) and the RBV (section 3.4.3.4) that R&D networks with external partners can be seen in itself as an O-augmenting advantage of the firm (Dunning, 2004). Other empirical HTSME internationalisation studies show the interconnection with R&D partners provides the HTSME complex bonds nurtured over time and therefore security and support in the dynamic internationalisation process in high-tech industries (Colombo et al, 2009). Therefore, as Li et al (2013) suggest, it should be easier for HTSMEs with a developed international R&D network to undertake foreign asset-augmenting FDI, as basic support structures for this activity have been previously established over a longer period. However, the underlying findings do not show this relationship and this rather supports the results of Schmiele (2012) who shows that the experience in R&D cooperation of German MNEs is not significantly related to their planned engagement in R&D activities abroad. Furthermore, the finding supports the results of Hollenstein's (2005) study of the internationalisation strategy of Swiss SMEs and MNEs. He demonstrates that the effect of R&D cooperation cannot be particularly related to foreign asset-exploiting or augmenting activities. Nevertheless, a frequency analysis outlined that asset-augmenting HTSMEs have more R&D cooperation than asset-exploiting HTSMEs. However, the difference between the two types of firms is not significant (see Appendix B2). An explanation can be derived from the HTSME context in a sense that both asset-exploiting and asset-augmenting HTSMEs might be required to engage in R&D cooperation and partnerships to remain innovative. The reason is the HTSME's lean structure and resource constraints, which implies that several activities are beyond its scope and skill-level (as outlined in section 2.3). Thus, it could be that all types of HTSMEs engage in R&D

cooperation to a certain extent, which might therefore explain why the result for the *R&D Network* variable does not show a significant difference between asset-augmenting HTSMEs and asset-exploiting HTSMEs.

The insignificance of the *Foreign Knowledge Implementation* does not support the hypnotised relationship to asset-augmenting FDI based on the notion of the dynamic capabilities perspective (section 3.4.3.6) in the entrepreneurial context (Cope, 2005). This study predicted that the direct implementation of the knowledge sourced by the subsidiary is supposed to enhance the firm-specific knowledge assets, and thereby support the HTSME in gaining a stronger position in its home market. Therefore, it appears that the interrelation between foreign sourced knowledge and the enhancement of the HTSME's competitive advantages is more intricate than proposed in the theoretical framework. An explanation for the insignificance of the variable might be that the foreign knowledge supposed to be implemented in order to contribute to the firm-specific advantage is based on more complex dynamic learning processes (Minniti and Bygrave, 2001). This foreign sourced knowledge might be tacit as it is not easily captured or codified (Leonard and Sensiper, 1999). This makes it difficult for HTSME managers to grasp and evaluate the extent of its contributory role, as it cannot be directly linked to innovations or business functions that immediately increase the competitive advantage. As very little is known about the asset-augmenting FDI of HTSMEs, the logic around the contributory role of knowledge implementation was developed following empirical studies in the MNE context (Arvanitis and Hollenstein, 2011; Oerlemans and Meeus, 2005). Furthermore, it was based on the MNE subsidiary roles literature, which views the subsidiary as an international creator (Nobel and Birkinshaw, 1998; Pearce, 1991). For example, Schmiele (2012) found that the knowledge implementation to innovation processes is also dependent on the international experience of the MNE. However, the descriptive results of this study did not show differences in the international experience between asset-augmenting and asset-exploiting HTSMEs.

Subsequently, this might be the reason why there is no significant difference between exploiting and augmenting HTSMEs in terms of *Foreign Knowledge Implementation*.

7.3.3 L-exploiting advantages and the FDI of HTSMEs

Building on the notions of location theory and the efficiency and market seeking FDI perspectives (section 3.4.5.3), the L-exploiting model was developed to test the L-exploiting advantages that are supposed to be specifically important for asset-exploiting HTSMEs. However, against the predictions developed in the conceptual framework, the findings did not show any significant differences in the importance of *Cost Factors* and *Market Factors* between HTSMEs that engage in asset-exploiting FDI and HTSMEs that undertake asset-augmenting FDI (H3a and H3b). However, in terms of *Market Factors*, the insignificant regression result does not mean that they are unimportant for the FDI decision of HTSMEs. The descriptive statistics of this study provide an explanation by showing a very high mean score of *Market Factors* from asset-exploiting HTSMEs and only a marginal lower, but still very high mean score from asset-augmenting HTSMEs (see Appendix B2). This implies that market factors are always important for all HTSMEs, regardless their engagement in exploiting or augmenting FDI. This finding is in line with Ojala and Tyrvainen (2008) who show that the market size of the potential host country is the most significant factor to explain the foreign entry of HTSMEs. It is further in line with the wider SME internationalisation literature, which consistently shows the high importance of market factors for the foreign entry of SMEs (Brouthers et al, 1996; Nakos and Brouthers, 2002; Pinho, 2007). Therefore, it appears that *Market Factors* are very important for both exploiting and augmenting HTSMEs. This explanation can be supported when looking at the analysis of host locations of exploiting and augmenting HTSMEs in this study (see discussion of the second research question in section 7.2.2). It outlined that the US is by far the most frequented target country for both types of FDI of HTSMEs (see Figure 6.10) due to the size of its high-tech market

(exploiting FDI) and its leading innovation system (augmenting FDI). Thus, on the example of the US, it is possible to delineate an explanation for the lack of difference in the importance of market factors between the two types of HTSMEs. It shows that international key locations in the high-tech sector can function as both, main target markets for foreign asset-exploiting activities (Abidi et al, 2011), as well as lead markets for asset-augmenting activities (Cleff et al, 2007).

A similar picture emerges regarding the *Cost Factors* as the results show that they are not significantly more important for asset-exploiting HTSMEs as hypothesised (H3a). According to Hatem (2011) and Rammer and Schmiele (2008), in the context of knowledge intensive MNEs, cost factors relate to the increased efficiency in production and adaptive R&D functions. However, the underlying finding implies that *Cost Factors* are not applicable to explain the FDI of asset-exploiting HTSMEs. An explanation for this unexpected results might be provided by a mean analysis of the *Cost Factors* scores. It shows that *Cost Factors* only have an average score for exploiting as well as augmenting HTSMEs (see Appendix B2). Therefore, the finding of this study implies that *Cost Factors* are for both types of HTSMEs not particularly important. This finding is in line with the result of Arvanitis and Hollenstein (2011) who outlines that cost reduction is not a key motivation for foreign engagement of firms in knowledge-intensive industries. However, the underlying finding does not conform to the current contribution of Li et al (2013) who explains that HTSMEs target least cost locations via the mode of internalisation. The authors derived this reasoning from a broader MNE perspective holding that firms shift parts of their production and adaptive R&D activities to lower cost locations (Edler, 2008; Kenney et al, 2009; Qu et al, 2013). However, this reasoning might not be applicable in the underlying HTSME context, which could explain the unimportance and related insignificance of *Cost Factors* in this study. As outlined in section 2.3, HTSMEs rather compete on a technological than a cost level due to their smaller size. Furthermore, the high-tech sector seems to be less sensitive

to cost differentials (see section 2.2). This explanation is in line with Hollenstein's (2009) study of Swiss SMEs and MNEs, which shows that cost-reducing strategies were of minor significance for the investing firms as their focus was rather on strategic knowledge aspects. It finds further support in the analysis of target countries for the FDI of HTSMEs discussed in the second research question of this study (see Figure 6.10). It revealed that the majority of the FDI from German HTSMEs in the sample is invested in the US and UK. These target countries do not significantly differ to Germany in terms of cost factors. Therefore, this implies that cost factors neither play a significant role in the FDI decision of asset-exploiting nor asset-augmenting HTSMEs.

7.3.4 L-augmenting advantages and the FDI of HTSMEs

The L-augmenting model was developed based on location theory (section 4.3.2) and the asset-augmenting FDI perspective (section 3.4.5.4). The diagnostics showed that the model explains the asset-augmenting FDI of HTSMEs very well. Specifically, the hypothesised relationships between asset-augmenting FDI and *Abundance of Highly Skilled Human Capital*, *Proximity to Scientific Institutions and Innovative Firms* and *Proximity to Industrial Concentrations* were supported. Concerning the *Abundance of Highly Skilled Human Capital (H4b)*, the finding confirms the implications of the literature linking economic geography and human capital theory (Florida, 2002; Green et al, 2013; Teixeira and Heyuan, 2012) in the new context of the asset-augmenting FDI of HTSMEs (section 3.4.5.4). It shows that the existence of an educated local workforce that embodies intangible technological knowledge is a highly important location factor for asset-augmenting HTSMEs. Thus, this finding in the HTSME context reinforces the need to recognise the role and scope of the quality of the local science base with skilled engineers and scientists as a key factor in the foreign location decision for higher value-added activities (Kuemmerle, 1999a; Narula and Santangelo, 2012). In line with the findings of previous studies, it implies that it has a

significant impact on the HTSME's innovation radicalness as it enables its foreign subsidiary to apply similar knowledge-processing systems as superior host country knowledge sources (Di Gregorio et al, 2009; Marvel and Lumpkin, 2007; Song et al, 2011).

Furthermore, building on cluster aspects (Porter, 1998), the L-augmenting model tested three individual factors (see section 4.3.2). The results reveal that the *Proximity to Scientific Institutions and Innovative Firms (H4c)* and *Proximity to Industrial Concentrations (H4f)* showed a significant relationship to asset-augmenting FDI. In contrast, the *Proximity to Innovative Suppliers (H4d)* shows an unexpected, although only weak, negative significant relationship to the asset-augmenting FDI of HTSMEs. This unexpected finding suggests that the measurement of cluster aspects at a disaggregate level might be more accurate than the measurement of a composite construct. In terms of the two positively significant cluster aspects, the underlying findings are consistent with the general assumptions of network perspective (section 3.4.3.3) in combination with the economic geography literature (Krugman, 1998; Porter, 1998). The findings support previous results of HTSME studies showing that the proximate location and associated interaction with scientific institutions and innovative firms is highly important for asset-augmenting HTSMEs (Freeman et al, 2010; Haeusler et al, 2012). It allows the HTSME to increase its innovative capabilities and to bundle competencies to keep up with global players in terms of innovation, information flow and market position (DeJongt and Freel, 2010; Kenny and Fahy, 2011).

It is further in line with the literature concerning the concept of the technological gatekeeper, implying that being part of an international network with universities, other firms and industry related organisations enables the firm to monitor the newest technological developments in the field (Buckley and Ghauri, 2004). Therefore, in combination with the contributions of Klepper (2010) on the concentration of industry related firms, the underlying findings imply that HTSMEs seek to locate proximate to innovative institutions

and firms to take advantage of informal knowledge networks and a larger pool of highly skilled labour. Accordingly, based on the network theory and experiential learning perspective (March, 1991), the findings imply that the asset-augmenting FDI of HTSMEs is dependent on learning opportunities through mutual exchange with a variety of proximate industry related partners. Moreover, the findings support the implication of Lewin et al (2009) that embeddedness in a spatial and sectoral concentration of related organisations mitigates the costs of locating and accessing foreign knowledge that remains in narrow geographical boundaries (Von Hippel, 1994).

However, as indicated above, the third cluster related factor, *Proximity to Innovative Suppliers*, shows a weakly negative significant relationship to asset-augmenting FDI. In other words, it seems to be slightly related to the asset-exploiting FDI of HTSMEs and therefore not in line with the prediction of hypothesis H4d. This was somewhat surprising given the theoretical assumptions on the relationship of cluster type knowledge advantages and foreign asset-augmentation (see section 4.3.2). An explanation might be context specific, as the factor has not been studied in the FDI and HTSME context before, due to the novelty of the underlying research topic. On first sight, existing theory suggests that the interaction process of the augmenting subsidiary with innovative local suppliers is an important component in the development process of innovations (Porter and Sölvell, 1998; Von Hippel, 1988). However, the underlying finding implies that the *Proximity to Innovative Suppliers* variable, which was derived from MNE literature, does not conform to the HTSME context. Its conceptual underpinnings do not hold and therefore it seems not generalisable to the context of HTSMEs. The reason might be that previous conceptual developments do not capture HTSME specific features. For example, HTSMEs often lack international experience and long developed relationships with other organisations in the foreign market due to their young age and resource scarcity (see section 2.3). Therefore, relationships to suppliers in the host country could be characterised by a lack of mutual understanding and

trust. However, trust and understanding has been highlighted a fundamental component in the relationship with local suppliers for the foundation of a shared stock of knowledge and the joint development of key innovations (Forsgren et al, 2005). It could also be possible that asset-augmenting HTSMEs rather rely on established home country suppliers in terms of major innovation related activities. This claim is in line with Johnsen's (2009) extensive synthesis of the literature concerning the involvement of suppliers in advanced innovation processes of the firm. He shows that it requires supplier relationship development built on a long-term process of integration and mutual trust.

In contrast, the relationship between asset-exploiting HTSMEs and innovative host country suppliers might rather concern the development of basic and less technology intensive components. Thus, the required amount of shared knowledge inputs and mutual trust might be considerably lower. This explanation is in accordance with David and Meyer (2004) who show an unexpected and slightly negative relationship between superior supply conditions in the host country and the MNE subsidiary's propensity to undertake R&D activities. The authors suggest that competence exploiting subsidiaries only engage in standardised innovation activities and are more likely to engage with innovative suppliers. Nevertheless, the finding of this study contradicts the literature of supplier involvement in new product development. It suggests that a considerable share of innovative activities stems from the learning interaction of the HTSME with advanced suppliers (Wagner and Hoegl, 2006). As such, Kampik and Dachs (2011) might provide a general explanation for these ambiguous results based on the context of Germany. They outline that foreign subsidiaries of German firms often use cooperations with host country suppliers as means to gain product adaptation knowledge rather than knowledge for new product development. This would explain the unanticipated association between the *Proximity to Innovative Suppliers* and asset-exploiting FDI of German HTSMEs.

The remaining two variables in the L-augmenting model, *Institutional Environment* related to innovation activities and *Home Country Disadvantage* of Germany, were not significant. Pertaining to the *Institutional Environment*, the finding is not in line with the conceptual implications around the role of institutions in relation to innovation activities (North, 1990; Scott, 1995). Accordingly, it does not conform to prior studies, which show that firms engage in asset-augmenting FDI in countries where the institutional environment provides low regulations and high legal protection (De Maeseneire and Claeys, 2012; Levin et al, 2009). As Ramasami et al (2012) outline, regulations hamper the innovative activities in a location and therefore deter knowledge seeking FDI. Furthermore, Rammer and Schmiele (2008) emphasise that institutional settings around intellectual property protection is a key factor to attract knowledge-seeking FDI. Nevertheless, the current results of Cannone and Ughetto (2014) support the underlying findings of this study. They show that the degree of patent protection does not affect the foreign location choice of HTSMEs. Hence, a partial explanation for the insignificance of the *Institutional Environment* related to innovation could be derived from the intellectual property protection perspective.

Consistent with the findings of Cannone and Ughetto (2014), the results of the O-exploiting model in this study reveal that patenting is not specifically important for the FDI of HTSMEs (see section 6.4.3.2). HTSMEs seem to be less concerned about the loss of proprietary knowledge due to the ever-decreasing life cycles of high-tech products, the reduced information asymmetry and the blurring of organisational boundaries (Ibeh et al, 2004). Accordingly, it seems that the *Institutional Environment* related to intellectual property protection might not be of particular importance for asset-augmenting HTSMEs. Furthermore, in terms of *Institutional Factors* related to regulations around innovation activities, the underlying findings are in line with Rammer and Schmiele (2008) who show that German SMEs do not perceive regulatory burdens as key institutional factors hampering innovation activities. Hence, it appears that augmenting HTSMEs have either developed

certain strategies and mechanisms to overcome regulations, or the targeted host countries provide a more conducive or at least similar *Institutional Environment* than the home country. This could be the case in this study as the descriptive analysis outlined that the main target country/region of German HTSME's asset-augmenting FDI is the US (see Table 6.10). It provides a less regulated institutional environment than Germany (Hall and Soskice, 2001). This might explain why the institutional environment is not significantly more important for asset-augmenting HTSMEs.

Pertaining to the *Home country Disadvantage*, the underlying results did not show a relationship to asset-augmenting FDI as predicted based on the innovation system literature (Hall and Soskice, 2001). Hence, it appears that the differences and limitations of the home country innovation system cannot be applied to explain the foreign knowledge sourcing FDI of HSMEs from coordinated market economies such as Germany. This finding is consistent with the current result of Schmiele (2012) who also did not find a significant association between the home country disadvantages in Germany and planned foreign knowledge sourcing FDI of German MNEs. Furthermore, it concurs with Allen et al (2011) who conclude that Germany provides a sufficient environment for firms to engage in radical innovation activities. Therefore, in combination with these recent consistent implications, the underlying finding challenges general assumptions in IB literature that HTSMEs from coordinated market economies such as Germany might undertake outward FDI in response to disadvantages in their home country (Hall and Soskice, 2001; Witt and Lewin, 2007). As outlined in section 2.5, Germany has been characterised as not conducive to radical innovation. Previous empirical research provide evidence for this claim by showing the negative impacts of the high coordination in Germany (Hall and Gingerich, 2004), and the related offshoring of innovation activities of German SMEs in response to the insufficient innovation system (Kinkel et al, 2007). An explanation for the ambiguity of the different results might be provided by Lehrer et al (2011) in the specific context Of Germany. They

show that the home-base compensating R&D of German firms in previous years might have stimulated R&D reform in Germany, which have then significantly improved the basic conditions for innovation activities. In fact, Germany has specifically introduced certain initiatives in 2006 to stimulate the entrepreneurial and competitive activities of German high-tech firms to create potential lead markets (as outlined in section 1.1). Therefore, consistent with Schmiele (2012), the results demonstrate the positive impact of these initiatives by outlining that German asset-augmenting HTSMEs did not undertake FDI to overcome specific limitations of their home country innovation system.

7.3.5 Summary of the O and L-advantages related to FDI

Several conceptual contributions have postulated the interconnection of O and L-advantages as key determinants of FDI (Dunning, 2008; Rugman, 2010; Narula, 2012; Narula and Santangelo, 2011, 2012). The arrows in the conceptual framework (Figure 4.1) visualised these connection via the FDI motivations of market seeking, efficiency seeking and strategic asset seeking FDI. On the example of the O and L-exploiting models, the significance of *Scale Economies* and the *Internal Support Structure* of the HTSMEs tallies with the high importance of *Market Factors* for both exploiting and augment HTSMEs (as outlined in Appendix B2). This finding is in line with the market seeking FDI perspective (section 3.4.5.3) and Kuemmerle's (1999a) seminal contribution showing that the firm's exploiting activities increase with the attractiveness of the host market. Nevertheless, as the remaining O and L-exploiting factors in the adopted framework of this study were not significant, the empirical results can only partly confirm Narula and Santangelos' (2011) conceptualisation that all O and L-advantages are concatenated and inextricably linked together.

In terms of the augmenting models, the O-advantages *Absorptive Capacity* and *Internal Knowledge Network* were significant. These findings tally with the significant L-augmenting advantages *Proximity to Scientific Institutions and Innovative Firms*, *Proximity to Industrial*

Concentrations and Abundance to Highly Skilled Human Capital. Therefore, these findings are in line with the strategic asset seeking FDI perspective (section 3.4.5.4) implying that foreign asset-augmentation is reliant on the HTSME's linkages with innovative actors in the host country. These findings also imply that the firm's ability to absorb and transfer knowledge within internal and external structures is essential. Furthermore, the implied connection between these significant O and L-augmenting advantages is in line with Kuemmerle (1999a) who shows that firms that are able to absorb and process knowledge undertake asset-augmenting FDI in locations that provide a high quality knowledge base. Thus, the underlying result contributes to the overall understanding of the reasons why German HTSMEs organise their foreign asset-augmenting FDI in specific host country locations. Nevertheless, not all tested O and L-augmenting advantages were significant in the models. Therefore, it is not possible to derive specific assumptions on all advantages tested in this study. However, the findings seem to support Narula (2012) who outlines that O and L-augmenting advantages can be co-evolutionary. More specifically, the findings imply that O-augmenting advantages can be shaped by internalised host country L-augmenting advantages, as suggested by Rugman (2010). In summary, these findings demonstrate a picture of how German HTSMEs organise their foreign asset-augmenting FDI. It seems to be dependent on a specific composition of HTSME specific O-augmenting advantages and host country specific L-augmenting advantages.

7.4 Suitability of envelope paradigm for analysing the types of FDI of HTSMEs

A key argument developed in this study is that commonly adopted theories and frameworks in HTSME internationalisation research are not able to explain the different types of FDI of HTSMEs (see section 1.3). Therefore, this study extends the field by testing if the envelope paradigm framework can be deployed to investigate and explain the various factors underlying the different types of FDI of HTSMEs. Therefore, this section relates to the

overall research aim (section 1.5) by evaluating if the envelope paradigm could be a useful analytical tool to explain the asset-exploiting and asset-augmenting FDI of HTSMEs. The model diagnostics (section 6.4.3.1) show that three out of four models were significant. This implies that the adopted envelope paradigm framework is partly able to deploy theories to categorise O and L-advantages in meaningful models to explain the different factors underlying the different FDI types of HTSMEs. Apart from the insignificant L-exploiting model, the explained variance of the remaining three models is similar or above the levels of related studies, which have not adopted the envelope paradigm framework. Nevertheless, the L-exploiting model lacked significance on first sight. However, as elaborated in section 6.4.3.4, this was based on the lack of response variation, which made the market factors variable appear as insignificant, although it was seen as a key location advantage for both exploiting and augmenting FDI by HTSME managers.

In general, these results imply that the O and L-augmenting facets seem to be more relevant to explain the FDI of HTSMEs than the O and L-exploiting facets (see Table 6.1). Thus, the results validate the envelope paradigm framework's ability to embrace the asset-augmenting FDI factors of HTSMEs derived from different theoretical perspectives. In comparison, only the O-exploiting model was significant while the L-exploiting model was insignificant. Hence, this result only partly validates the explanatory power of the adopted envelope paradigm framework in terms of the factors explaining the asset-exploiting of HTSMEs. In summary, this implies that the augmenting models are more useful in the HTSME context than the exploiting models. Furthermore, the overall results show that the different theoretical approaches organised within the envelope paradigm such as RBV, KBV, dynamic capabilities perspective, internalisation theory, network theory, location theory etc. were able to explain a comparatively large share of the complex nature of the different types of FDI of HTSMEs.

This is an important contribution to the research field as the literature review reveals that several components of previously adopted theoretical approaches in HTSME internationalisation research seem to lack applicability in the new context of the different FDI types of HTSMEs. These approaches were rather complementary as they lacked explanatory power on their own (as synthesised in section 3.5). Furthermore, this study provides empirical evidence to justify the claims of previous studies that the OLI envelope paradigm is more than a loose bundle of related theories. For example, Buckley and Hashai (2009) formalised in a theoretical paper internationalisation in the OLI paradigm by reconfiguring concepts of new classical economics in a general equilibrium model. They bridge the diverse views about the MNE held by IB scholars and international trade economists and offer a model to empirically test certain aspects of the paradigm framework. In terms of the incorporation of strategic knowledge aspects in the framework, the authors conclude “we are able to model the emergence of knowledge-asset seeking FDI with the same modelling tools as used to model more conventional operation modes” (Buckley and Hashai, 2009:67). This study contributes to their theoretical discussion by providing empirical results showing how a specific modelling of the envelope paradigm framework enables the researcher to explain the knowledge seeking FDI of HTSMEs. The conceptual framework (Figure 4.1) visualises this particular configuration of the paradigm and the O-augmenting model (sections 6.4.3.3) and L-augmenting model (section 6.4.3.5) reveal several significant knowledge-related variables (see Table 6.1). Therefore, this study contributes to the literature discussing the suitability of the envelope paradigm framework in the particular context of knowledge seeking HTSMEs.

It provides empirical evidence for the claims made in the synthesis of the literature review (section 3.5) that the envelope paradigm framework is able to account for the underlying factors related to the HTSME’s quest to acquire new knowledge and capabilities abroad. Thus, the empirical findings inform Abidi et al’s (2011) theoretical principle that,

complementary to Dunning's (2000) conceptualisation of strategic asset-seeking FDI, the market seeking FDI perspective could be additionally used by HTSMEs as a function to access foreign knowledge sources. The empirical finding related to the *Market Factors* variable outlined in section 6.4.3.4 supports this claim. It reveals that host market factors are almost equally targeted by HTSMEs that undertake asset-exploiting and asset-augmenting FDI. This implies that market seeking FDI is not only important for asset-exploiting activities but equally for asset-augmenting activities in the host country. In summary, this study shows that the envelope paradigm framework is suitable to partly explain the asset-exploiting FDI, and very suitable to explain the asset-augmenting FDI of HTSMEs. This finding lends credence to previous conceptual approaches in the literature suggesting that the updated envelope paradigm incorporating dynamic O and L-advantages is able to serve as an analytical framework to understand the knowledge seeking FDI of SMEs (Abidi et al, 2011; Almor and Hashai, 2002). As an extension of these conceptual approaches, this study is the first to empirically test and validate the envelope paradigms ability to embrace relevant theories to explain the knowledge related aspects of the FDI of HTSMEs. The following chapter states the core contributions of this study.

8. Conclusion

8.1 Core contributions to knowledge

The aim of this study was to examine the relationship between the envelope paradigm and different types of FDI in the new context of HTSMEs. Therefore, this study contributes to knowledge and demonstrates that an existing IB framework is able to explain the configuration of HTSMEs that undertake different types of FDI (Abidi et al, 2011; Almor and Hashai, 2002). Previous literature called for more holistic and integrated approaches to explain the international activities and FDI of HTSMEs (Coviello and McAuley, 1999; Kuivalainen et al, 2012; McAuley, 2010; Ruzzier et al, 2006; Whitelock, 2002). In line with the literature and research aim (section 1.5), the underlying results provide several core contributions to knowledge.

First, this study advances existing knowledge by providing useful insights about the ability of the envelope paradigm to explain a relative large extent of the differences between asset-exploiting and asset-augmenting FDI of HTSMEs. Thereby, it contributes to the interdisciplinary debate on the compatibility and suitability of an IB framework in an entrepreneurial context. It integrates the main findings of previous literature (see synthesis of the literature review) to provide a holistic and comprehensive framework that develops a picture of the structure and composition of HTSMEs that engage in different types of FDI. This advancement of the field relates directly to the second and third core contributions of this study.

Second, it reveals that the theoretical development of the envelope paradigm leading to an inclusion of more dynamic knowledge related O and L-advantages (see section 3.4.5.4), is conducive to the explanation of the differences between the asset-exploiting and asset-augmenting FDI of HTSMEs. This emphasises that the envelope paradigm is able to integrate and merge the theoretical underpinnings of the KBV, dynamic capabilities perspective, cluster type geographical aspects and network theory within the new context of

firms that combine characteristics of smaller entrepreneurial SMEs and larger international MNEs.

Third, the study shows that the traditional and more static O and L-advantages organised in the adopted envelope paradigm (see section 3.4.5.3), are only partly able to explain the differences between the asset-exploiting and asset-augmenting FDI of HTSMEs. While the framework was able to integrate the RBV and the efficiency seeking and market seeking FDI perspectives to explain differences in O-exploiting advantages, it was not able to explain differences in L-exploiting advantages between asset-exploiting and asset-augmenting HTSMEs. In particular, the framework was unable to explain differences in market and cost factors between HTSMEs that engage in asset-exploiting and asset-augmenting FDI. This lack of explanatory power could be attributed to the general high importance of market factors and medium importance of cost factors for any type of HTSME, disregarding its engagement in exploiting or augmenting FDI.

Overall, this study demonstrates that the envelope paradigm framework can generally serve as an analytical framework for understanding the different types of FDI of HTSMEs. It additionally highlights that the framework still requires further investigation and modification to fully explain all underlying aspects of the different FDI types of HTSMEs. The three core contributions outlined above are in response to previous literature, which has outlined that commonly adopted research approaches in the field of HTSME internationalisation are unable to fully explain the comprehensive mechanisms related to the FDI of HTSMEs (see synthesis of the literature review). Hence, by extending the conceptual propositions of Abidi et al (2011), this study provides a more comprehensive and eclectic approach. This is an important contribution to knowledge as previous theoretical development in the context of FDI has almost exclusively been conducted from the perspective of large MNEs (Li et al, 2013; Pinho, 2007; Ruzzier et al, 2006). Hence, the

results of this study extend the field by expanding the applicability of an adjusted IB framework designed for large MNEs to capture the distinct nature of HTSMEs' asset-exploiting and asset-augmenting FDI. This was achieved by the integration of FDI theory with existing knowledge on the internationalisation and FDI of HTSMEs in a comprehensive envelope paradigm framework. This contribution to knowledge can be seen as a direct response to Abidi et al's (2011) request for future research to provide empirical results illustrating the trends of foreign asset-exploitation and exploration within the FDI of HTSMEs. It further contributes to Gassmann and Keupp (2007) who request more eclectic theory building in the context of HTSME internationalisation.

8.2 Empirical contributions

This study contributes to the empirical literature on three levels. First, as the choice of the market entry mode is a key component within the HTSME's internationalisation strategy (Morschett et al, 2010), it reveals patterns of determinant firm characteristics that distinguish HTSMEs with FDI, from HTSMEs with non-equity entry. By comparing and contrasting the configuration of HTSMEs with different entry modes, this study extends the HTSME entry mode literature, which has mainly been concerned with the explanation of non-equity entry modes and the accelerated timeframe of HTSME internationalisation in the past (Cannone and Ughetto, 2014; Melen and Nordman, 2009; Ojala and Tyrvainen, 2008; Zhou and Ghauri, 2010). The results show that HTSMEs with FDI are older, larger and more internationally experienced than HTSMEs engaging in non-equity entry modes. This implies that the accelerated timeframe of HTSMEs' internationalisation might not be applicable to the mode of FDI as it appears that age and experience are indeed relevant factors. This result contributes to the description of internationalised HTSMEs by altering essential elements as suggested by Bello and Kostova (2012). In particular, the well explored mode of non-equity entry was altered to the very little explored equity entry mode.

Second, this study investigated if firm-specific characteristics can function as determinants of the HTSME's engagement in different types of FDI. Thus, it follows the suggestion of Pinho (2007) to investigate in more detail the potential differences existing within one broad category of foreign market entry, namely the unexplored FDI category. This is an important extension of knowledge as implications related to the different types of FDI have so far been mainly derived from related studies of large MNEs (Kuemmerle, 1999a, 1999b; Makino et al, 2002). The results reveal that HTSMEs with asset-exploiting FDI do not significantly differ from HTSMEs with asset-augmenting FDI in terms of age, size, international experience and industry. This result was unexpected as Abidi et al (2011) derive in a theoretical paper the proposition that international HTSMEs follow an incremental investment strategy starting with exploiting activities turning towards augmenting activities once the firm has gained more experience. This proposition is based on the traditional FDI literature suggesting that the foreign investment path is rather incremental (Blomkvist et al, 2010). Accordingly, the results of this study advance the knowledge in the field by showing that implications of firm-specific characteristics derived from the large MNE literature might not hold in the specific context of the asset-exploiting and asset-augmenting FDI of HTSMEs. Building on this result, this study further extends the analysis, which is the third empirical contribution of this study.

Third, this study responds to the call for more research to investigate the different types of FDI of HTSMEs (Abidi et al, 2011; Li et al, 2011, 2013). In particular, it extends existing knowledge by explaining the conditions that induce HTSMEs to undertake asset-exploiting and asset-augmenting FDI by drawing on the two key perspectives of O and L-advantages. The conceptualisation of the different FDI types was developed by integrating traditional MNE and FDI literature (Dunning, 2000; Kuemmerle, 1999a; Makino et al, 2002), with the few contributions that have previously been provided in the field of the FDI of HTSMEs (Abidi et al, 2011; Almore and Hashai, 2002; Li et al, 2011; 2013). However, previous

HTSME research has only theoretically approached the question regarding the relevant factors for the asset-exploiting and asset-augmenting FDI of HTSMEs (Abidi et al, 2011). Therefore, the novelty of this study lies in the empirical results, which show that HTSMEs' engagement in different types of FDI is indeed sensitive towards some ownership and location parameters.

In terms of the asset-exploiting FDI and the question why HTSMEs invest abroad from an O-exploiting perspective (Eden and Dai, 2010), the results provide a mixed picture. They affirm that some traditional O-exploiting advantages such as the ability to take advantage of scale economies and the internal support structure are relevant in the new context of the asset-exploiting FDI of HTSMEs. Furthermore, the results extend existing knowledge by highlighting that other traditional O-exploiting advantages seem not to be more relevant for the asset-exploiting FDI of HTSMEs. Regarding the L-exploiting perspective, the results cannot explain differences in the importance of L-exploiting advantages between the asset-exploiting and asset-augmenting FDI of HTSMEs. This finding implies that general predictions from theory might not hold in the new HTSME context and should therefore be revisited.

In terms of the asset-augmenting FDI from an O-augmenting perspective, the results extend existing knowledge by showing that not all O-augmenting advantages are equally important in the new HTSME context. In particular, the results show that advantages such as absorptive capacity and internal knowledge network facilitate cross border knowledge augmentation in the HTSME context. Moreover, the results add to existing knowledge by highlighting that some O-augmenting advantages do not differ in their relevance for the asset-exploiting and asset-augmenting FDI of HTSMEs. Regarding the L-augmenting advantages, the results affirm that the relationship between the host country's endowment of valuable knowledge sources and asset-augmenting FDI (Makino et al, 2002) is valid to a large extent in the new

context of HTSMEs. Moreover, this study adds novel insights to the knowledge stock of the national systems of innovation literature, which classified Germany as a coordinated market economy with an incremental innovation system that is not conducive to rapid innovation (Hall and Soskice, 2001; Kaiser and Prange, 2004). However, the results of this study suggest that HTSMEs do not perceive the German innovation system as unfavourable for innovation activities. This novel finding suggests that previous findings should be revisited. Furthermore, this finding extends the knowledge around the under-explored phenomenon of outward FDI as an escape response to weak home country institutional conditions (see Witt and Lewin, 2007).

8.3 Methodological contribution

This study provides a robust quantitative methodological approach in the new research context of FDI and HTSMEs. It adopted a novel feature in FDI research by collecting data from the headquarters manager and not the subsidiary manager. This approach overcomes the weaknesses of previous studies in subsidiary and FDI research, which did not attach particular consideration to the role of the individual key decision maker, namely the general manager of the firm (Collinson and Houlden, 2005; Pinho, 2007). However, this neglected perspective is highly significant, specifically in the context of smaller HTSMEs, as the decision to undertake a certain FDI type is enabled by the boundedly rational manager.

Another methodological contribution relates to the adoption and validation of survey measures from surveys of large MNEs to the new HTSME context. This was a necessary step, as hardly any quantitative study of the FDI of HTSMEs exists. Furthermore, several other factors make this study unique. For example, it is the first survey of its kind and it was conducted in a context where no HTSME and FDI survey has been undertaken before. Moreover, it applied a unique database to develop a bespoke sample of HTSMEs for the empirical investigation. Although the sample is comparatively small, it is representative as

nanotech and biotech firms are at the forefront of high-tech industries (OECD, 2010). Therefore, it allows a high degree of generalisation, at least in the context of Germany and other coordinated market economies (Hall and Soskice, 2001) and probably beyond.

Another important aspect relates to the cross-cultural nature of this research project. The researcher emerged himself into the research context of the study by embedding in a local university in the country where the study was conducted (as described in section 5.4.6). This allowed a more rigorous and efficient data collection process and had a positive effect on the response rate of the electronic survey. This particular survey method further allows to target respondents that are widely dispersed in the large country.

8.4 Implications for public policy

By emphasising the role of the global HTSME (Lloyd-Reason and Sear, 2007), this study implies that governmental support schemes have to meet the new requirements of HTSMEs engaging in equity intensive entry modes. As HTSMEs play a significant role in the development of industrialised countries (European Commission, 2013), policy makers should revisit and extend governmental support schemes to extend the traditional focus on export activities to support more resource intensive entry modes. Policy makers should acknowledge the possibilities provided by the increasing international presence of HTSMEs, as it represents a new channel for FDI, international trade and foreign knowledge exchange. Accordingly, this has a positive effect on the international competitiveness of domestic high-tech industries and domestic employment (Zapkau et al, 2013). Hence, the identification of relevant factors for the FDI of HTSMEs in this study provides guidance for policy makers in assisting their national HTSMEs to develop stronger international competitiveness and to expand their global market share. This kind of assistance to HTSMEs can contribute to a country's long-term socio-economic development and prosperity. Particularly in the case of advanced economies which are relying on the development of knowledge intensive

industries (Chen et al, 2009; Fryges, 2009). However, so far political support has often focused on large MNEs by neglecting the important role of HTSMEs (Zapkau et al, 2013). The underlying results suggest that policy makers should mitigate this imbalance.

As policy makers have an interest in the national competitiveness and the establishment of a strong position in emerging technologies (Allen et al, 2011), this study provides valuable implications related to the high-tech sector in a country. The findings imply that public and private scientific research institutions, industrial concentrations and highly skilled R&D employees in a country constitute the fundamental force behind the development and success of high-tech industries. Policy makers can consult these findings in order to evaluate which type of FDI they can attract in consideration of the existing location factors in their country (Kuemmerle, 1999). Furthermore, the findings support policy makers in taking appropriate action to develop a supportive environment for high-tech industries by drawing on the identified factors in this study. Another interesting implication relates to previous research suggested that national institutional frameworks influence the efficacy of such actions (Holmes et al, 2013; Narula and Santangelo, 2012). In terms of HTSMEs, the findings of this study imply that institutional factors such as intellectual property protection and governmental regulations to innovation activities do not significantly affect the location choice of HTSMEs. This finding provides a new perspective for policy makers as previous research (Ramasami et al, 2012; Schmiele, 2008) suggested that policy makers should invest resources to ensure and maintain a high standard of these factors.

Another key policy implication of this study is the finding that German HTSMEs do not undertake strategic asset seeking FDI to overcome the limitations of the German innovation system. These limitations were identified by seminal academic contributions (e.g. Hall and Soskice, 2001). This could imply that policy initiatives to stimulate the innovative environment in high-tech industries, such as the German High-tech Strategy (see section

1.1), seem to have a positive long-term effect on the international competitiveness of coordinated market economies, which have been seen as not conducive to radical innovation. Accordingly, this study implies that policy makers in coordinated market economies could adopt certain strategies from the example of Germany to overcome drawbacks to innovation activities in their national innovation system.

8.5 Managerial implications

The results of this study can assist managers in formulating internationalisation strategies that enable the firm to exploit and enhance its existing advantages across borders. This kind of advice is particularly important in the underlying context of HTSMEs as “these firms are often headed by scientists, technologists and engineers with considerable expertise in the technological aspects of their business. However, their business capability and know-how may be less well developed” (Jones, 2001:207). Pertaining to the foreign entry mode of HTSMEs, the results revealed that the engagement in FDI is not limited to large MNEs anymore. However, this study also showed that implications of the MNE FDI literature cannot be directly adapted to HTSMEs, as these considerably differ in various aspects (see section 1.2). Accordingly, this study provides an explanation of different firm characteristics, which are important for HTSMEs that engage in non-equity entry modes and HTSMEs that undertake FDI. HTSME managers should clearly evaluate if their firm has gained enough international experience and possesses sufficient resource endowments to undertake equity entry. Given the fact that inappropriate entry mode decisions are difficult and costly to reverse (Pinho, 2007), these findings provide valuable guidance for HTSME managers to make financially sound entry mode choices.

Another key managerial implication relates to the HTSMEs international configuration of its asset-exploiting or asset-augmenting FDI, as no previous data in the specific HTSME context exists. Assuming that the strategic configuration of the HTSME’s FDI is a key point

within its internationalisation process (Li et al, 2013), this study provides managers a systematic approach to identify O and L factors, which are relevant for the different types of FDI. A key assumption is that certain static firm-specific and location specific advantages facilitate the HTSME's asset-exploiting FDI. In terms of asset-augmenting FDI, this study implies that the configuration of the HTSME's knowledge creation is globally dispersed, as it is increasingly conducted within and outside the home country. The findings suggest that besides the firm-specific knowledge related advantages, HTSME managers must develop a clear picture of the availability and accessibility of different knowledge sources in the host country. The integration in local industrial concentrations with innovative organisations seems to be particularly important in that sense. Additionally, the access to highly skilled labour should be a key point on the managers' internationalisation agenda.

Furthermore, it seems that the level of governmental regulations and intellectual property protection in the host country is of lower importance than suggested in related literature (Wrona and Trapczynski, 2010). This implies that managers must evaluate if they are willing to invest valuable resources into the organisation of patent registrations and international legal enforcement. Another strategy could be to use these resources to enhance innovation activities in order to take advantage of the short high-tech product lifecycles. Thus, by accelerating the speed of new product development, managers can naturally mitigate the risk of losing proprietary knowledge. Moreover, it appears that HTSMEs managers predominantly decide to undertake knowledge related FDI in countries with a strong institutional environment, where the individual firm profits from a stable political system related to intellectual property protection. Hence, the underlying results can offer important insights for managers regarding the foreign location decision for their FDI. The US is the most important target country for both asset-exploiting and asset-augmenting FDI. This is probably due to its unique combination of being one of the largest high-tech markets by additionally providing highly valuable knowledge assets. Continental European countries

are the second most targeted for exploiting and augmenting FDI while China has been predominantly targeted for asset-exploiting FDI. These examples show how the host location analysis in this study can support managers to find the most suitable host location depending on the strategic objectives of the FDI.

Moreover, this study showed on the example of Germany that the competitiveness of domestic innovation systems might change over time due to different external factors such as political support schemes. For the FDI decision of HTSMEs, this means that managers should not rely too much on their perception of established and maybe dated evaluations of the competitiveness of a national innovation system. Instead, managers should seek to consult up to date empirical data to evaluate the specific advantages provided by different host countries in relation to the existing advantages in their home country. Such an in-depth development of FDI strategies based on the most currently available data is crucial for HTSMEs due to their resource limitations, which do not allow any failure (Li et al, 2011). In summary, the main results of this study support HTSME managers to make a more profound decision in terms of foreign entry mode. They can apply the developed framework to structure the configuration of their FDI activities according to firm-specific abilities and location specific attributes.

8.6 Limitations of the study

This study suffers from some conventional limitations. Concerns could be raised regarding the generalisability of the findings for HTSMEs as the sample draws on firms from only two industries. However, the nanotech and biotech industries used in this study are at the forefront of high-tech industries and are therefore seen as representative for nascent industries with cutting-edge innovations (OECD, 2010; Zou and Ghauri, 2010). Another limitation relates to the comparatively small sample size in this study as it could raise concerns about the representativeness. However, a small sample size is not unusual for

exploratory research of this nature (Kenny and Fahy, 2011; Pinho, 2007; Schwens et al, 2011). Furthermore, the relative high response rate in this study and the high representativeness of the respondents should mitigate this limitation. Moreover, the extensive tests for representativeness in this study were satisfactory (see section 5.6.2).

Another limitation relates to the specific country context of Germany, which might restrict the generalisability of the findings. However, Germany is an exemplar of a coordinated market economy (Hall and Soskice, 2001). Therefore, the results should be representative for other coordinated market economies as well. Nevertheless, results should be generalised with caution. For example, while implications on the firm-specific O-advantages might be comparatively stable in different country contexts, the country specific L-advantages are certainly more context specific and vary across different countries. Moreover, this study suffers from some conventional limitations as all cross-sectional studies do. The cross-sectional research design is not able to capture the dynamic processes within the internationalisation process of HTSMEs. Additional panel and longitudinal data could provide a more comprehensive picture of the entry mode development, as HTSMEs might commence international activities with non-equity entry modes and gradually engage in resource intensive modes. However, given the novelty of this study, the cross-sectional results might pinpoint aspects to be investigated in longitudinal and panel studies.

A further limitation relates to the use of many perceptual self-reported measures of O and L-advantages in this study. It is acknowledged that perceived abilities of the HTSME might rather reflect a desired condition and that perceived L-advantages might differ significantly from reality (Brouthers et al, 2003). This bares the risk of common method bias (CMB). However, extensive tests in this study showed that the CMB is not severe (see section 6.2.3). Further, the nature of the questions in this study required the response of the key decision maker. He/she is the only one that can provide an accurate assessment of the underlying

reasons of HTSMEs to engage in different types of FDI. Moreover, Makino et al (2002:414) highlight that “Although there is the danger of self-reporting bias, research has found that perceived measures were correlated positively with objective measures.” Furthermore, the use of self-reported measures are commonly adopted and verified in related studies (Brouthers et al, 2003; Pinho, 2007; Presutti et al, 2007). Another limitation might relate to the time span between and the point in time when the FDI was undertaken and the point in time when the data on the underlying reasons to engage in FDI was collected. As Brouthers et al (2003) highlight, there is a possibility that managers reflect and adjust their perception over time and therefore do not provide an accurate description of the attitudes that influenced the FDI decision when it was undertaken.

8.7 Future research

The development of a holistic framework that is able to capture and explain the various aspects underlying the HTSME’s engagement in different types of FDI remains challenging. Further investigation is required, especially regarding the relevant theoretical underpinnings that allow the researcher to develop a conceptual base containing all important factors for the explanation of the different FDI types. This raises the question if there is a framework that is able to explain asset-exploiting and asset-augmenting FDI more accurate than the one adopted in this study. Further in-depth empirical research is required to comprise additional reasoning to the ongoing debate. It is hoped that the results of this study provide a conceptual ground for future research and stimulate additional theoretical and empirical investigation.

This study has integrated a large body of research related to the comparatively new strategic asset seeking perspective in the envelope paradigm, as dynamic and knowledge related advantages are highly significant in the HTSME context (Cannone and Ughetto, 2014; Keupp and Gassmann, 2009). This effort is reflected in the high explained variance of the augmenting models. However, additional research is needed to establish a more

comprehensive integration of the theoretical implications of the static asset-exploiting advantages and the efficiency seeking FDI of HTSMEs, particularly in the context of L-exploiting advantages. This could provide further clarification regarding the mechanisms of how HTSMEs take advantage of exploiting factors in order to exploit their existing assets and generate income in the host country. This question can be further extended by an investigation of if and how HTSMEs employ income-generating tools in order to cross-finance the augmentation of competitive knowledge advantages in the host country. Answers provided to these questions would allow for a more detailed modeling of the underlying factors of the different FDI types HTSMEs undertake.

Although beyond the scope of this study, the results raise questions related to the dynamic process and time-frame of the domestic HTSME becoming a new type of small MNE by engaging in FDI. Among these questions worthy of further investigation are: What are the underlying forces enabling the HTSME to internalise and manage foreign entities under consideration of its resource constraints (Spence, 2003)? Is the born global approach, suggesting the HTSME's accelerated internationalisation in terms of non-equity entry modes, also valid in terms of the HTSME's engagement in different types of FDI? Or do HTSMEs rather pursue a more stepwise and incremental approach commencing with asset-exploiting FDI activities gradually being accompanied by asset-augmenting FDI activities, as it has been the case for larger MNEs? Future research should investigate these critical questions with a longitudinal research design. Longitudinal data will allow to capture the dynamic processes underlying the HTSME's development of its FDI. Thus, it will complement the cross-sectional data provided by this study. It will also allow to draw conclusions on the cause and effect relationships between the investigated variables. This would further enhance the knowledge created by this study as the cross-sectional data did not allow to explain e.g. if the HTSME's ability to take advantage of scale economies enables

it to undertake asset-exploiting FDI, or if the asset-exploiting FDI allows the HTSMEs to develop economies of scale.

Additionally, future research should adopt a qualitative research approach to investigate the FDI of HTSMEs from a micro perspective. For example, case studies would provide a fertile ground for theory and knowledge development in the field (Kenney et al, 2009). A qualitative research agenda could explore managerial processes that lead the decision to undertake FDI and investigate how firms coordinate the asset-exploiting and augmenting activities between their home base and the foreign entity. The coordination of these FDI activities raises further questions related to the diverse country specific advantages in the home and host country. Future research should investigate the underlying reasoning of HTSMEs from other coordinated market economies such as Sweden and liberal market economies such as the US (Hall and Soskice, 2001) to engage in different types of FDI. Furthermore, it should investigate the FDI types of HTSMEs from emerging economies such as China. Within this process, future research can test the applicability of the conceptual framework adopted in this study in a different country setting with a different innovation system. This would extend the underlying findings of this study and advance the research field towards a holistic framework that is able to fully explain the different types of FDI of HTSMEs.

Appendix

Appendix A: Contact email and questionnaire

Appendix A1: English version



**EUROPA-
UNIVERSITÄT
VIADRINA
FRANKFURT
(ODER)**



Dear ...

ownership- and location advantages are often considered to be significant factors for innovative activities and international competitiveness of firms. This research project investigates how specific ownership and location advantages affect the innovative capability of German high-tech SMEs. The study is conducted by the Europa University Viadrina Frankfurt (Oder) in association with the Manchester Metropolitan University Business School.

We would be grateful if you could complete the multiple choice questionnaire below. This will require less than 10 minutes of your time. The results of the study are important to support government policies in the high-tech sector. We are happy to send you a summary of our findings, which will provide you a comprehensive overview of the foreign activities of German high-tech SMEs and the international competitiveness of the German innovation system.

Please note that your **information/responses will be strictly confidential**. Results from this questionnaire will be reported in aggregate form, no firm will be named in any publication/report. Please return the questionnaire by clicking the submit button on the last page.

Thank you very much for your cooperation

David Freund

For any additional information, please contact:

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Questionnaire on foreign activities of German high-tech SMEs

1. General information

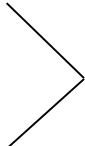
- 1.1 When was your firm established?
- 1.2 What is the approximate number of employees at your firm worldwide?
- 1.3 Does your firm engage in foreign activities? If yes, since how many years?

If firm is not active abroad, please return the questionnaire now by clicking on the “return questionnaire” button at the end of the questionnaire.

2. Your firm’s foreign activities

- 2.1 Tick the **first answer** applicable to your firm.

Subsidiary (entity with >50% equity)	<input type="checkbox"/>
Joint venture with equity	<input type="checkbox"/>
Joint venture without equity	<input type="checkbox"/>
Partnership	<input type="checkbox"/>
Cooperation	<input type="checkbox"/>
Export	<input type="checkbox"/>



Only **one**
answer
possible

- 2.2 Where does the foreign activity chosen in 2.1 take place?

Attention: If your firm conducts the chosen activity several times (e.g. several foreign subsidiaries), report on the most important from your perspective.

- 2.3 Only answer if you chose **in question 2.1 ‘subsidiary or equity joint venture’**. What is the approximate share of following activities there?

R&D		
• product or service adaptation of existing products		%
• product or service development of new products		%
Production of goods or services		%
Marketing & Sales		%
Distribution / Logistics		%
Others (please specify) _____	_____	
		100%

3. Firm-specific information

- 3.1 What is the approximate percentage of employees with an academic degree in the headquarters?
- 3.2 What is the approximate percentage of employees directly or indirectly associated with R&D in the headquarters?

- 3.3 Please evaluate the amount of R&D co-operations your firm was engaged in within the last 3 years on a scale from 1 (none) to 7 (a lot).

If your firm **only engages in export**, please return the questionnaire now by clicking on the “return questionnaire” button at the end of the questionnaire. Otherwise continue with 3.4.

- 3.4 Please evaluate your firm’s ability regarding the following activities from 1 (none) to 7 (a lot).

Development of differentiated products

Development of patents in the headquarters

Adaptation of firm-specific technology to foreign demand

Support of foreign sales or production from headquarters

Reduction of unit costs through large production volumes

- 3.5 Please state your agreement with the following statements concerning your firm from 1 (strongly disagree) to 7 (strongly agree).

We perfectly understand the knowledge accessed abroad.

We can easily acquire the new knowledge accessed abroad

- 3.6 Please state your agreement with the following statements concerning your firm from 1 (strongly disagree) to 7 (strongly agree).

The knowledge of the German headquarters is transferred to the foreign subsidiary respectively foreign equity joint venture, joint venture, partnership or cooperation.

The knowledge of the foreign subsidiary respectively foreign equity joint venture, joint venture, partnership or cooperation is transferred to the German headquarters.

- 3.7 Please state your agreement with the following statement concerning your firm from 1 (strongly disagree) to 7 (strongly agree).

The knowledge sourced abroad is important for the development of our products and patents.

4. Innovation in Germany

- 4.1 Please state your agreement with the following statements regarding the German innovation system From 1 (strongly disagree) to 7 (strongly agree).

There is a lack of high skilled R&D employees in Germany

There is a lack of demand for innovative products in Germany

Innovation costs are high in Germany

Government regulations and red tape are high in Germany

5. The foreign location factors

5.1 Please evaluate following foreign location factors regarding their importance on **your foreign activity chosen in question 2.1** from 1 (not important at all) to 7 (very important).

Cost factors (e.g. lower production cost, lower adaptive R&D costs)

Market factors (e.g. market size, growth potential, access to surrounding markets)

Low government regulations and red tape to innovation activities

High intellectual property protection

Proximity to leading universities and private and public scientific institutions

Proximity to innovative firms

Access to highly skilled employees directly or indirectly involved in R&D

Proximity to innovative suppliers

High industrial concentration (industrial parks, technological networks, etc.)

Thank you very much for your co-operation

Your position: _____

Appendix A2: German version



**EUROPA-
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FRANKFURT
(ODER)**



Sehr geehrte/r ...

wettbewerbs- und Standortvorteile werden oft als ausschlaggebende Faktoren für Innovationsaktivitäten und Wettbewerbsfähigkeit von Firmen gesehen. Dieses Forschungsprojekt untersucht die Auswirkung von speziellen Wettbewerbsvorteilen und Standortvorteilen auf die Innovationsfähigkeit von deutschen mittelständischen Hightech-Unternehmen. Die Studie wird durchgeführt von der Europa Universität Viadrina Frankfurt(Oder) in Zusammenarbeit mit der Manchester Metropolitan University.

Wir wären Ihnen sehr dankbar, wenn Sie sich zehn Minuten Zeit nehmen könnten um den multiple choice Fragebogen auszufüllen. Die Ergebnisse dieser Studie tragen dazu bei wirtschaftspolitische Maßnahmen der Regierung im Hightech Bereich gezielter zu gestalten. Gerne senden wir Ihnen eine Zusammenfassung unserer Ergebnisse zu. Diese ermöglicht Ihnen einen umfassenden Überblick über die Auslandsaktivitäten von deutschen mittelständischen Hightech-Unternehmen und die internationale Wettbewerbsfähigkeit des deutschen Innovationssystems.

Firmeninformationen und Antworten werden **streng vertraulich** behandelt. Ergebnisse dieser Studie werden ausschließlich in zusammengefasster Form präsentiert, keine Firma wird namentlich in einer Veröffentlichung oder Bericht erwähnt. Bitte senden Sie den Fragebogen zurück durch das anklicken des 'Fragebogen zurücksenden' Buttons am Ende des Fragebogens.

Vielen Dank für Ihre Mithilfe.

David Freund

Für weitere Informationen wenden Sie sich bitte an:

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Befragung über Auslandsaktivitäten von deutschen mittelständischen Hightech-Unternehmen

1. Allgemeine Informationen

- 1.1 Wann wurde Ihre Firma gegründet?
- 1.2 Wie viele Mitarbeiter beschäftigt Ihre Firma ungefähr weltweit?
- 1.3 Ist Ihre Firma im Ausland aktiv? Falls ja, seit wie vielen Jahren?

Falls Firma nicht im Ausland aktiv ist, bitte Fragebogen jetzt zurück senden durch das anklicken des 'Fragebogen zurücksenden' Buttons am Ende des Fragebogens.

2. Die Auslandsaktivitäten Ihrer Firma

- 2.1 Die **erste zutreffende** Antwort für Ihre Firma ankreuzen.

Ausländische Niederlassung (Eigenkapital >50%)
Ausländische Beteiligung (Eigenkapital ≥10%)
Joint Venture im Ausland
Partnerschaft im Ausland
Kooperation im Ausland
Export

☐
☐
☐
☐
☐
☐

Nur **eine**
Antwort
möglich

- 2.2 Wo findet die in Frage 2.1 ausgewählte Auslandsaktivität gewählt statt?

Achtung: Falls Ihre Firma die gewählte Aktivität mehrfach betreibt (z.B. mehrere ausländische Niederlassungen), berichten Sie über die ihrer Meinung nach wichtigste.

- 2.3 Nur beantworten falls in **Frage 2.1 ausländischen Niederlassung oder Beteiligung gewählt wurde**. Was ist der ungefähre Anteil folgender Aktivitäten dort?

F&E

- Produkt- und/oder Serviceanpassung von existierenden Produkten %
- Produkt- und/oder Serviceanpassung von neuen Produkten %

Produktion von Gütern und Dienstleistungen %

Marketing & Verkauf %

Vertrieb / Logistik %

Andere, nämlich: _____

100 %

3. Firmenspezifische Informationen

- 3.1 Wie hoch ist der ungefähre Anteil von Akademikern im Headquarter?
- 3.2 Wie hoch ist der ungefähre Anteil von Angestellten die direkt oder indirekt an F&E beteiligt sind im Headquarter?

- 3.3 Bitte beurteilen Sie die Anzahl an F&E Kooperationen die Ihre Firma in den letzten drei Jahren hatte auf einer Scala von 1 (keine) bis 7 (sehr hohe).

Falls Ihre Firma **nur durch Export im Ausland aktiv** ist, senden Sie bitte den Fragebogen jetzt zurück durch das anklicken des 'Fragebogen zurücksenden' Buttons am Ende des Fragebogens. Ansonsten fortfahren mit 3.4.

- 3.4 Bitte beurteilen Sie die Fähigkeit Ihrer Firma bezüglich folgender Aktivitäten von 1 (keine) bis 7 (sehr hohe).

Entwickeln differenzierter Produkte

Entwickeln von Patenten im Headquarter

Anpassen von firmenspezifischer Technologie an ausländische Nachfrage

Unterstützen des ausländischem Verkaufs oder Produktion durch das Headquarter

Reduzieren der Stückkosten durch große Produktionsvolumen

- 3.5 Bitte geben Sie Ihre Zustimmung bezüglich der folgenden Aussagen von 1 (stimme überhaupt nicht zu) bis 7 (stimme voll und ganz zu).

Wir verstehen voll und ganz das im Ausland vorhandene Wissen

Wir können uns sehr einfach das im Ausland vorhandene Wissen aneignen

- 3.6 Bitte geben Sie Ihre Zustimmung bezüglich der folgenden Aussagen von 1 (stimme überhaupt nicht zu) bis 7 (stimme voll und ganz zu).

Das Wissen des deutschen Headquarters wird transferiert zur ausländischen Niederlassung bzw. ausländische Beteiligung, Joint Venture, Partner oder Kooperation.

Das Wissen der ausländischen Niederlassung bzw. ausländische Beteiligung, Joint Venture, Partner oder Kooperation wird zum Headquarter transferiert.

- 3.7 Bitte geben Sie Ihre Zustimmung bezüglich der folgenden Aussagen von 1 (stimme überhaupt nicht zu) bis 7 (stimme voll und ganz zu).

Das im Ausland gesammelte Wissen ist wichtig für die Entwicklung unserer Produkte und Patente

4. Innovation in Deutschland

- 4.1 Bitte geben Sie Ihre Zustimmung zu folgenden Aussagen über das deutsche Innovationssystem von 1 (stimme überhaupt nicht zu) bis 7 (stimme voll und ganz zu).

Es gibt ein Mangel an F&E Fachkräften in Deutschland

Es gibt mangelnde Nachfrage nach innovativen Produkten in Deutschland

Innovationskosten sind hoch in Deutschland

Staatliche Regulierung und bürokratische Hürden sind hoch in Deutschland

5. Die ausländischen Standortfaktoren

5.1 Bitte beurteilen Sie wie wichtig folgende Standortfaktoren im Ausland für Ihre **in Frage 2.1 ausgewählte Auslandsaktivität** sind von 1 (überhaupt nicht wichtig) bis 7 (sehr wichtig).

Kostenfaktoren (z.B. geringer Produktionskosten, geringere F&E Kosten)

Marktfaktoren (z.B. Marktgröße, Wachstumspotential, Zugang zu umliegenden Märkten)

Niedrige staatliche Regulierung und bürokratische Hürden in Innovationstätigkeiten

Hoher Schutz von geistigem Eigentum

Nähe zu führenden Hochschulen sowie öffentlichen und privaten Forschungseinrichtungen

Nähe zu innovativen Firmen

Zugang zu qualifizierten Fachkräften direkt oder indirekt an F&E beteiligt

Nähe zu innovativen Lieferanten

Hohe Industriekonzentration (Industrie Parks, Technologie Netzwerke, etc.)

Vielen Dank für Ihre Zusammenarbeit

Ihre Position: _____

Appendix B: Descriptive statistics

Appendix B1: Extensive descriptives

Item	N	Miss.	Mean	Median	Mode	Std. Dev.	Min.	Max.
Age	68	0	23.49	20	12	16.75	4	74
Size	68	0	103.24	70	30	97.72	6	420
Int. Experience	68	0	15.21	14	10	11.48	1	60
Industry	68	0	0.74	1	1	0.44	0	1
Prod. Differentiation	68	0	5.99	6	6	1.20	2	7
Tech. Adaptation	68	0	5.29	6	6	1.50	1	7
Patenting	68	0	3.87	5	5	2.02	1	7
Intern. Supp. Structure	68	0	5.82	6	6	0.99	3	7
Scale Economies	68	0	3.31	3	2	1.67	1	7
Innov. Capability	68	0	29.01	20	20	22.25	4	100
R&D Network	68	0	4.74	5	5	1.46	2	7
Underst. Foreign Knowl.	68	0	5.18	6	6	1.50	2	7
Acquis. Foreign Knowl.	68	0	4.81	5	5	1.51	2	7
Know. Transf. HQ Subs.	68	0	4.84	5	6	1.61	1	7
Know. Transf. Subs. HQ	68	0	4.40	5	5	1.61	1	7
For. Know. Implemen.	68	0	4.65	5	5	1.67	1	7
Cost factors	68	0	3.38	3	1	2.10	1	7
Market factors	68	0	6.41	7	7	0.99	3	7
Low. Gov. Regulations	68	0	3.94	4	5	1.82	1	7
High Intell. Prop. Protect.	68	0	4.26	5	6	2.17	1	7
Abund. Skill. Hum. Capital	68	0	3.88	4	3	1.97	1	7
Prox. Scien. Institutions	68	0	4.12	4	5	1.76	1	7
Prox. Innovative Firms	68	0	4.03	4	5	1.80	1	7
Prox. Innovative Suppliers	68	0	3.34	3	2	1.72	1	7
Prox. Industrial Concentr.	68	0	4.37	5	6	1.91	1	7
Lack R&D Employees	68	0	4.06	4	2	1.80	1	7
Lack Dem. Innov. Prod.	68	0	2.73	2	2	1.47	1	6
High Innovation Costs	68	0	4.63	5	5	1.68	1	7
High Gov. Regulations	68	0	4.57	5	5	1.71	1	7

Appendix B2: Mean analysis of asset-exploiting and asset-augmenting HTSMEs

Variable	Asset-exploiting HTSMEs	Asset- augmenting HTSMEs
	Mean	Mean
Age	22.00	25.88
Size	96.95	113.38
Int. Experience	15.31	15.04
Industry	-	-
Prod. Differentiation	6.12	5.77
Tech. Adaptation	5.48	5.00
Patenting	4.07	3.54
Intern. Supp. Structure	6.07	5.42
Scale Economies	3.69	2.69
Innovative Capability	24.02	37.08
R&D Network	4.45	5.91
Absorptive Capacity	4.27	6.15
Intern. Knowl. Network	3.98	5.65
For. Know. Implementation	4.40	5.04
Cost factors	3.38	3.38
Market factors	6.55	6.19
Institutional Environm.	4.29	3.79
Abund. Skill. Hum. Capital	3.07	5.19
Prox. Scien.Institut/Inno.Firms	3.39	5.17
Prox. Inno. Suppliers	3.26	3.46
Prox. Indust. Concentr.	3.71	5.42
Home Country Disadvantage	4.01	3.98

Appendix C: Diagnostics

Appendix C1: Transformed variables

Variable	Transformation
<i>Age</i>	Log Age
<i>Size</i>	Log Size
<i>International Experience</i>	Sqrt Internationala Experience
<i>Patent Development</i>	Log Patent Development
<i>Scale Economies</i>	Sqrt Scale Economies
<i>Innovative Capability</i>	Log Innovative Capability
<i>Cost Factors</i>	Log Cost Factors
<i>Abundance Highly Skilled Human Capital</i>	Log Abundance Highly Skilled Human Capital
<i>Proximity Innovative Suppliers</i>	Log Proximity Innovative Suppliers

Appendix C2: Outliers

Variable	Identified cases	Modification as suggested by Field (2009:153)
Age HQ	58, 120, 133	Mean + 2 standard deviations
Internal support structure	75	Next highest score + 1
Market factors	190	Next highest score +1
Low demand innov. products	69, 111, 121	Mean + 2 standard deviations

Appendix C3: Influential cases

Diagnostic measure	Threshold value specification	Threshold value	Identified cases Control model	Identified cases O-exploiting model
Residuals				
Standardised	t-value	± 1.96	-	-
Studentised	t-value	± 1.96	-	82
Studentised deleted	t-value	± 1.96	-	82
Leverage				
Hat values	$3(k+1)/n$	a)	58	-
Mahalanobis		15	58	-
Single case measures				
Cook's distance	$4/(n-k-1)$	b)	58	62, 158
COVRATIO	$1 \pm [3(k+1)/n]$	c)	37, 58, 85	18, 23, 121, 152,
SDFFIT	$v[(k+1)/(n-k-1)]$	d)	3, 20, 38, 58, 62, 82, 106, 121, 128, 141, 156, 185, 197, 202	3, 20, 38, 58, 62, 82, 91, 105, 106, 128, 139, 150, 177, 185, 197, 202
Critical cases deleted			58	-

- a) Threshold value for Control model (0.221) and O-exploiting model (0.265)
b) Threshold value for Control model (0.063) and O-exploiting model (0.065)
c) Threshold values for Control model (1.220&0.779) and O-exploiting model (1.256&0.735)
d) Threshold value for Control model (0.282) and O-exploiting model (0.311)

Diagnostic measure	Threshold value specification	Threshold value	Identified cases O-augmenting model	Identified cases L-exploiting model
Residuals				
Standardised	t-value	± 1.96	186	-
Studentised	t-value	± 1.96		-
Studentised deleted	t-value	± 1.96	186	-
Leverage				
Hat values	$3(k+1)/n$	a)	-	190
Mahalanobis		15	38	-
Single case measures				
Cook's distance	$4/(n-k-1)$	b)	186	190
COVRATIO	$1 \pm [3(k+1)/n]$	c)	18, 38, 84, 105	58
SDFFIT	$v[(k+1)/(n-k-1)]$	d)	18, 38, 58, 62, 91, 106, 119, 150, 159, 177, 186, 202, 204	3, 20, 38, 58, 82, 91, 92, 95, 106, 121, 128, 139, 141, 150, 152, 156, 159, 177, 185, 186, 197, 202, 204
Critical cases deleted			186	-

- a) Threshold value for O-augmenting model (0.265) and L-exploiting model (0.132)
b) Threshold value for O-augmenting model (0.065) and L-exploiting model (0.061)

- c) Threshold values for O-augmenting model (1.265&0.735) and L-exploiting model (1.132&0.868)
d) Threshold value for O-augmenting model (0.311) and L-exploiting model (0.215)

Diagnostic measure	Threshold value specification	Threshold value	Identified cases L-augmenting model
Residuals			
Standardised	t-value	± 1.96	106
Studentised	t-value	± 1.96	106, 186
Studentised deleted	t-value	± 1.96	106, 186
Leverage			
Hat values	$3(k+1)/n$	a)	-
Mahalanobis		15	18, 59, 185
Single case measures			
Cook's distance	$4/(n-k-1)$	b)	18, 106, 186
COVRATIO	$1 \pm [3(k+1)/n]$	c)	59, 69, 75, 106, 185
SDFFIT	$\sqrt{[(k+1)/(n-k-1)]}$	d)	3, 82, 105, 106, 128, 139, 150, 152, 185
Critical cases deleted			106

- a) Threshold value for L-augmenting model (0.309)
b) Threshold value for L-augmenting model (0.066)
c) Threshold values for L-augmenting model (1.309&0.691)
d) Threshold value for L-augmenting model (0.339)

Appendix C4: Pearson's r correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12
1 Type of FDI	1											
2 Log_FirmAge	,086	1										
3 Log_FirmSize	,003	,566**	1									
4 Sqrt_InternationalExperience	-,005	,706**	,482**	1								
5 Industry	,061	,120	,157	,313**	1							
6 ProductDifferentiation	-,142	-,329**	-,108	-,151	,216	1						
7 TechnologyAdaptation	-,155	,228	,283*	,153	-,038	,167	1					
8 Log_PatentDevelopment	-,183	-,080	,137	-,172	,019	,174	,136	1				
9 InternalSupportStructure	-,320**	-,196	-,110	,006	,163	,235	,085	,039	1			
10 Sqrt_ScaleEconomies	-,298*	,161	,322**	,074	-,114	-,102	,030	,348**	,089	1		
11 Log_InnovativeCapaility	,189	-,423**	-,535**	-,446**	-,197	,161	-,150	,100	,084	-,215	1	
12 R&DNetwork	,248*	-,123	-,046	-,245*	,028	,134	-,133	,021	,111	-,070	,161	1
13 AbsorptiveCapacity	,659**	,038	-,038	,020	,069	-,044	-,077	-,014	-,222	-,144	,233	,222
14 InternalKnowledgeNetwork	,591**	,119	,055	,010	,099	,081	,026	,036	-,109	,154	,109	,203
15 ForeignKnowledgeImplemnt.	,185	-,014	,038	,035	,033	,190	,107	,183	-,020	,122	,160	,199
16 Log_CostFactors	-,016	,051	,041	,038	,133	,142	,073	,026	,143	,116	,044	,126
17 MarketFactors	-,175	-,023	,204	,167	,115	,155	,216	,065	-,001	-,119	-,146	-,242*
18 InstitutionalEnvironment	-,141	-,087	,141	-,039	,169	,241*	,018	,424**	,145	,244	,071	,134
19 Log_AbunHighSkillHumCapit	,527**	-,056	-,007	-,080	-,052	,054	-,095	-,030	,089	-,080	,262*	,444**
20 ProxScienInstitulInnovFirms	,540**	-,190	-,142	-,165	,038	,031	-,175	,109	,078	,008	,260*	,565**
21 Log_ProxInnovativeSuppliers	,085	,028	,076	,031	-,002	-,049	,101	,092	,104	,092	,061	,198
22 ProxIndustrialConcentration	,439**	-,068	-,098	-,040	,152	,048	-,158	-,080	-,162	-,065	,075	,346**
23 HomeCountryDisadvantage	-,013	-,030	-,103	-,088	,035	,241*	,019	,120	,078	-,125	,199	,168

Notes: *p < 0.05 (two-tailed), **p < 0.01 (two-tailed); N=68

Pearson's correlation matrix continued

	13	14	15	16	17	18	19	20	21	22	23
13 AbsorptiveCapacity	1										
14 InternalKnowledgeNetwork	,711**	1									
15 ForeignKnowled.Implenta.	,414**	,483**	1								
16 Log_CostFactors	,154	,154	,189	1							
17 MarketFactors	-,169	-,138	-,037	,092	1						
18 InstitutionalEnvironment	-,007	,023	,117	,236	,063	1					
19 Log_AbunHighSkillHumCapit	,407**	,401**	,313**	,198	-,208	,303*	1				
20 ProxScienInstituInnovFirms	,432**	,375**	,374**	-,024	-,321*	,250*	,613**	1			
21 Log_ProxInnovaiveSuppliers	,107	,133	,328**	,402**	-,066	,379**	,508**	,308*	1		
22 ProxIndustrialConcentration	,432**	279*	298*	,117	-,057	,206	,401**	619**	,359**	1	
23 HomeCountryDisadvantage	-,043	-,051	-,126	,129	,122	,257*	,205	021	,289*	,122	1
Notes: *p < 0.05 (two-tailed), **p < 0.01 (two-tailed); N=68											

Appendix C5: Multicollinearity

Control model	VIF
Firm Age	1.257
Firm Size	1.047
International Experience	1.299
Industry	1.329

O-exploiting model	VIF
Product Differentiation	1.110
Technology Adaptation	1.066
Patent Development	1.103
Internal Support Structure	1.109
Scale Economies	1.077

O-augmenting model	
Innovative Capability	1.723
R&D Network	1.111
Absorptive Capacity	1.609
Internal Knowledge Network	1.058
Foreign Knowl. Implementation	2.073

L-exploiting model	
Cost Factors	1.015
Market Factors	1.472

L-augmenting model	
Institutional Environment	1.191
Abun.Highly Skill.Hum. Capital	1.875
Prox.Scient. Insti & Innov. Firms	2.650
Prox. Innovative Suppliers	1.529
Prox. Industrial Concentration	1.912
Home Country Disadvantage	1.735

* All variables were used in their transformed for

Appendix C6: Split sample tests

Split sample Control Model		
	Sample A	Sample B
Firm Age	1.955(2.229)	-0.711(2.099)
Firm Size	-0.269(0.917)	0.037(0.854)
Internat. Experience	-0.090(0.456)	0.059(0.429)
Industry	0.781(0.990)	-0.336(0.948)
Model Chi Square	2.368	0.320
Nagelke R ²	0.086	0.012

***<1%, **<5%, *<10% (2-tailed)

Split sample O-exploiting Model		
	Sample A	Sample B
Internal Support Structure	-0.880(0.457)**	-1.663(0.728)**
Scale Economies	-1.768(0.993)**	-4.410(1.522)**
Model Chi Square	8.124**	21.159***
Nagelke R ²	0.303	0.630

***<1%, **<5%, *<10% (2-tailed)

Split sample O-augmenting Model		
	Sample A	Sample B
Absorptive Capacity	2.077(0.975)**	3.996(1.851)**
Internal Knowledge Netw.	2.926(1.461)**	2.263(1.321)*
Model Chi Square	31.463***	29.526***
Nagelke R ²	0.813	0.798

***<1%, **<5%, *<10% (2-tailed)

Split sample L-exploiting Model		
	Sample A	Sample B
Cost Factors	-1.256(1.290)	1.432(1.158)
Market Factors	-0.331(0.326)	-0.299(0.305)
Model Chi Square	2.223	2.403
Nagelke R ²	0.092	0.091

***<1%, **<5%, *<10% (2-tailed)

Split sample L-augmenting Model		
	Sample A	Sample B
Abu.Highly Skill.Hum.Cap.	9.541(4.484)**	13.182(4.990)**
Prox.Scienc.Inst.Inno.Firm	0.496(0.652)	-0.184(0.789)
Prox. Innovative Suppliers	-5.369(2.936)	-6.648(3.422)*
Prox. Indus. Concentration	0.660(0.395)**	0.982(0.453)**
Model Chi Square	20.279***	26.917***
Nagelke R ²	0.650	0.746

***<1%, **<5%, *<10% (2-tailed)

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